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ELECTRICAL NEWS

AND

STEAM ENGINEERING JOURNAL.

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MR. J. J. WRIGHT.

THE subject of the accompanying portrait was born in Yarmouth, England, in 1850, and came to Canada about twenty-one years ago. Mr. Wright was in the States at the time of the Centennial Exhibition, of 1876, at which time electricity was beginning to attract attention as a possible means of giving light. He there became acquainted with Prof. Thomson, who was then occupying the Chair of Chemistry in the High School, in Philadelphia, Pa., at which time he in conjunction with Prof. Houston of the same school was commencing experiments which have led up to the brilliant results of to-day. Mr. Wright built all the machinery during these experiments; he also built and put up the first electric street lamp on the continent of America, which was placed on the corner of 21st street and Washington ave. in the year 1879. He was amongst the first to handle electric light wires in the construction of underground service, having constructed a line of underground wire for electric lighting in Market street, Philadelphia, and another between the City Hall and 4th street. Mr. Wright was a member of the National Conference of Electricians convened by the United States Government, and whilst in Philadelphia was a member of the Franklin Institute of Science and Arts, and is now connected with the Electric Light Association of the United States.



MR. J. J. WRIGHT.

In the spring of 1883 Mr. Wright returned to Canada and built a small plant for the supply of light which was operated on Yonge street near King, and since then he has identified himself with the electric lighting interests of this city as manager of the Toronto Electric Light Company. He also built and put in operation the electric locomotive which has been used at the Industrial Exhibition for the past few years—which may be considered the pioneer electric railroad in Canada.

SAFETY VALVES—THEIR HISTORY, ANTECEDENTS, INVENTION AND CALCULATION.

BY WILLIAM BARNET LE VAN.

The function of a safety valve, as used on a steam boiler, is to discharge steam so rapidly, when the pressure within the boiler reaches a fixed limit, that no important increase of pressure can then occur, however rapidly steam may be made. It should be so constructed and arranged, that should any accident occur, it may be opened by hand and the steam pressure lowered very rapidly, even when the grates are covered with a mass of incandescent fuel, and steam is being generated rapidly, without increasing the pressure in the boiler over 10 to 15 per cent. above that to which the valve may be loaded.

The grate surface, all things considered, is the best unit of measurement for determining the size of safety valves. The ordinary rate of combustion runs from 10 to 15 pounds of coal per square foot of grate, and the rate of evaporation may be taken at 9 pounds of water per pound of coal as the maximum.

The higher the pressure the smaller the orifice will have to be; and on the other hand, the lower the pressure the larger must the outlet be. A boiler in which the pressure does not exceed 40 pounds per square inch, may require from 30 to 40 square inches of area; while the same quantity of steam would escape through 4 square inches of area in a boiler carrying 150 pounds pressure.

A safety valve should not exceed 4 inches in diameter; when a valve of larger area than 4 inches is wanted, an extra safety valve should be added. The area of a valve increases nearly as the square of its diameter; the circumference, directly as the diameter. The escape of the steam is around the circumference, and it will be understood, of course, that a point would soon be reached in which the area would be of little account if carried to large diameters and figuring on ordinary valves. For example, if the grate area required a common valve 6 inches in diameter, it would have a circumference of 18.84 inches; the same area would be furnished by two 3½-inch valves, the combined circumferences of which would equal $9.621 \times 2 = 19.242$ inches.

As the safety valve is the main reliance in case of neglect or inattention of the engineer or fireman, it is important to carefully examine its mode of operation and the ordinary methods of construction and calculation for safety. However, before proceeding as above, we will endeavor to give the early history of the safety valve, as well as the antecedents, invention and the manner of proportioning and calculating all its parts. As this is a subject that has already been very carefully traversed, I do not pretend to offer much that is new or original, but will try to give that which will be the most useful, for the benefit of a portion of the rising generation, as well as for some others who may be interested, and in as simple language as is consistent with plainness; so that any one who can solve simple equation in algebra, and who knows the simple definitions of trigonometry, and the elements of physics, shall understand it. Mathematics will be dispensed with as far as possible; but in each case, where possible, written rules, together with the particulars of working examples, will be given, so that the reader may study the subject for himself.

STEAM.

As the first result of the application of heat to a solid substance is to dilate it, and the next to melt it, so also the further application of heat converts it from a liquid into a vapor or gas. The point at which successive increments of heat, instead of raising the temperature, are absorbed in the generation of vapor, is called the "boiling point" of the liquid. Different liquids have different boiling points under the same pressure, and the same liquid will boil at a lower temperature in a vacuum, or under a low pressure, than it will under a high pressure. As the pressure of the atmosphere varies at different altitudes, liquids will boil at different temperatures at different altitudes, and the height of a mountain may be approximately determined by the temperature at which water boils at its summit.

DIFFERENCES BETWEEN GASES AND VAPORS.

Vapors are saturated gases, or, gases are vapors surcharged with heat. Ordinary steam is the saturated vapor of water, and if any of the heat be withdrawn from it, a portion of the water is necessarily precipitated. This is not so in the case of a gas under ordinary conditions. But if the gas be forced into a very small bulk, it will follow that any diminution of the temperature will cause a portion of the gas to condense into a liquid. Superheated steam resembles gas in its qualities, and a portion of the heat may be withdrawn from such steam without producing the precipitation of any part of its constituent water. (*Bourne*).

Steam was among the motive agents of the most ancient idols of Egypt (as the statue of Memnon, and others), and some of the deified images of Europe; and it is curious to note that it should formerly have been employed with tremendous effect to delude men—to keep them in ignorance—while now it contributes so largely to enlighten and benefit mankind.

Steam has, of course, been noticed ever since the heating of water and cooking of food were practiced. The daily occurrence implied by the expression "the pot boils over," was as common in antediluvian as in modern times; and hot water thus raised was one of the earliest observed facts connected with the evolution of vapor. From allusions in the most ancient writings, we may gather that the phenomena exhibited by steam were closely observed of old. Thus, Job, in describing Leviathan, alludes to the puffs, or volumes, that issue from under the covers of boiling vessels: "By his neesings a light doth shine, and his eyes are like the eyelids of the morning; out of his nostrils goeth smoke [steam] as out of a seething pot or cauldron." In the early use of the vessels last named, and before experience had rendered the management of them easy and safe, women would naturally endeavor to prevent the savory contents of their pots from flying off in vapor; hence attempts to confine it by covers; and when these did not fit sufficiently close, a cloth, or some similar substance, interposed between it and the edge of the vessel, would readily suggest itself, and a stone or other weight placed upon the top to keep all tight would also be very natural. Then, as the fluid began again to escape, further efforts would be made to retain it by additional weights. In this manner, doubtless, many a contest was kept up between a pot and its owner till one gained the victory; and we need not the testimony of historians to determine which one this was. In those times it was not generally known that a boiling cauldron contained a spirit, impatient of control; that the vessel was the generator of an irresistible power, and the cover a *safety valve;* and that the preservation of the contents and the security of the operator depended upon letting the cover alone, or not overloading it; hence it no doubt often happened that the confined vapor threw out the contents with violence, and then it was that primitive cooks began to perceive that there was death as well as life in a boiling pot. In this manner, we suppose women were the first experimenters with steam (engineers), and the earliest witnesses of steam boiler explosions.

Ancient priests, both among the Jews and Gentiles, were, from their ordinary duties, necessarily conversant with the generation of steam. Its elastic force could not, therefore, escape the shrewd observers among them. Sacrifices were frequently *boiled* in huge cauldrons, several of which were permanently fixed in the vicinity of temples—in "boiling places," as their locations are named by Ezekiel, "where the ministers of the house shall boil the sacrifice of the people."

It would seem, moreover, as if some of the boilers were made on the principle of Papin's digester, in which bones were softened by "high steam"; at any rate, a distinction is made between seething pots and cauldrons, and from the manner in which both are mentioned they seem to have been designed for different purposes; the former to seethe or soften bones, the latter to boil the flesh in only. "They roasted the passover with fire, but the other offerings sod they in pots and in cauldrons," (ii. Cor. chap. 35, p. 13). "Set on a pot, set it on, and also pour water into it. Gather the pieces thereof into it, even every good piece, the thigh and the shoulder; fill it with the choice bones. Take the choice of the flock and burn (or heap) also the bones under it, and make it *boil well*, and let them *seeth the bones* of it therein." (Ezek. 24, p. 3, 5). The belief that the Jews had close vessels in which steam was raised higher than in common cauldrons, is also rendered probable from the fact that the Chinese, a contemporary people, employ similar ones, and which, from their tenacity to ancient devices, have probably been used by them from time anterior to those of the prophets. ("Davis' Chinese," ii. 271; "John Bell's Travels," i. 296, and ii. 13).

Some of the ancient philosophers, who were close observers of nature, compared the earth to a cauldron, in which water is heated by internal fires; and they explained the phenomena of earthquakes by the accummulation of steam in subterraneous caverns, until its elastic energy rends the superincumbent strata for a vent. Vitruvius explains by it the existence of boiler springs. In the reign of Justinian, Anthemius, an architect and mathematician, illustrated several natural phenomena by it; but of this we should probably never had heard had it not been for a quarrel between him and his next door neighbor, Zeno, the rhetorician. This orator appears to have inherited a considerable share of credulity and superstition, which gave his antagonist the advantage. Anthemius, we are informed, had several steam boilers in the lower part of his house, from each of which a pipe conveyed the vapor above, and by some mechanism, of which no account has been preserved, he shook the house of his enemy as by a real earthquake, upon which the affrighted Zeno rushed to the Senate, "and declared in a tragic style that a mere mortal must yield to the power of an antagonist who shook the earth with the trident of Neptune."

The boiler engineer of to-day, noting the curious things in bronze and in copper exhumed at Pompeii, and gathered together in the Musco Borbonico, at Naples, will linger near a small vessel for heating water, little more than a foot high, in which are combined nearly all the principles involved in the modern vertical steam boiler—fire box, smoke flue through the top, and fire door at the side, all complete; and, strange to say, this little thing has a *water grate*, made of some small tubes crossing the fire-box at the bottom, an idea that has been patented twenty times over, in one shape or another, within the period of the history of the steam boiler.

The boilers of the fast boats built by the Herreshoff Company, of Bristol, R. I., are similar in construction to those found in the Thermae at Pompeii, taken from impressions left in the mortar or cement in which they were embedded. Some idea of the capacity of these boilers may be derived from the fact that a single establishment could accommode *two thousand persons* with warm, or rather *hot*, baths at the same time. Seneca, in a letter to Lucilius, says "there is no difference between the heat of the baths and a *boiling furnace*"; and it would, he observes, appear to a reasonable man as a sufficient punishment to wash a condemned criminal in them. The persons who had the charge of heating in close vessels and distributing daily such large quantities of water, must necessarily have been conversant with the mechanical properties of steam, and the economical modes of generating it.

(To be Continued.)

TRADE NOTES.

Says the Port Hope *Guide:* "We noticed a large shipment of Spooner's Copperine going to Goldie & McCulloch, Galt, a day or two since. It's a production of our town—it's the metal above all other metals, and this settles it. There will not be a hot box for miles around Galt as long as Copperine holds out."

The Dominion Leather Board Co., of Montreal, have purchased the property and water power at Sault au Recollect, near Montreal, formerly owned by Messrs. McNiven & Cole, including saw mill, grist mill and what is familiarly known as Sault au Recollect Paper Mills, and are making alterations in saw mill to use it for their leather board and friction board mill, and will run the paper mill on building, roofing, sheathing and flooring felts.

Mr. H. W. Petrie, dealer in machinery of all kinds, who has been energetically building up a business all over Canada, announces the removal of his headquarters from Brantford to Toronto. This step became necessary because his increased transactions require the best facilities for transportation, also buildings and appliances for handling heavy machinery, etc. Therefore he has built new brick premises 40 x 124 feet, near the Union Station, on Front St., west of the Walker House, with massive beams, steel girders, steam hoists, and every facility for handling heavy goods, and ighted by electricity.

A piece of mica was recently taken from the mines near Buckingham, Que., which measured 7 feet 6 inches in height and 38 inches thick. This is said to be the lagest solid piece in America.

PLANT EFFICIENCY WITH OPEN AND CLOSED CIRCUIT TRANSFORMERS.

By William Stanley, Jr.

Several contributions on the relative merits of the closed and opened circuit transformers for the distribution of electrical energy, have lately appeared in *The Electrical Engineer*. In various letters, Mr. Swinburne has maintained that the open circuit transformer is more efficient than is its opponent of the closed magnetic circuit type, and that, consequently, American engineers were applying and advocating apparatus lacking maximum efficiency.

When, in 1885, I constructed the first closed transformer, and adapted it for commercial lighting, I had in mind the very differences which are now being discussed, and at the same time there seemed to me to exist certain objections to open circuit transformers which still appear to me to be of such magnitude that I believe, in America at least, the open circuit transformer is at a disadvantage. Of these objections I have seen no mention; they are briefly as follows:

In the open circuit transformer of the Ruhmkorff, the Gaulard and Gibbs, or the hedgehog type, high efficiency is due to the fact that the fluid (or air) portion of the magnetic circuit causes the current phase to lag behind the E. M. F. more than in the closed magnetic type, and in a well constructed transformer of the open circuit type this lag is nearly 90 deg. at no load, that is, when the secondary circuit is open. Now in these transformers the value of the primary current varies comparatively little with the load derived from the secondary circuit, and when such a transformer is gradually loaded, the primary current will remain, roughly speaking, constant, while the lag of the current behind its E. M. F. will diminish; the phases of current and E. M. F. more nearly coinciding as the energy taken from the transformer is increased.

In the closed circuit type of transformer, however, the *value of the primary current in amperes* is very nearly in direct proportion to the load upon the secondary circuit. Thus while the primary current in the open circuit type remains, roughly speaking, constant, possibly varying 10 to 20 per cent., the primary current in the closed type is proportional to the load.

Let us examine briefly the station requirements for the two contrasted types. With the open circuit type eight-tenths of the station plant, that is, eight-tenths of all the engines and dynamos, must run continual to supply the primary currents, for the ampere value of these currents is about constant; while with the closed circuit type of transformer, the engines and dynamos in service vary in proportion to the number of lamps burning. Thus, in a station having 10 dynamos and engines of equal size, in many places one dynamo and engine will easily supply all the energy necessary during twelve or fourteen hours out of the twenty-four, when the closed circuit or American type of transformer is used; while, with the open circuit type advocated by Mr. Swinburne, at least eight of such engines or dynamos would be required to do the same work. The question arises, therefore, Which system uses the least fuel, and costs the least?

For the sake of simplicity, we will allow Mr. Swinburne's transformer to have 100 per cent. efficiency. We will also allow the closed circuit transformer an efficiency of 95 per cent., which can be proven to be commercial practice in well designed transformers. Placing the engine losses at 10 per cent. and neglecting the losses in the mains, we find that with the open circuit type the loss is eight times as much as with the closed type, neglecting transformer losses; or 7.6 times, including these losses. In short, it requires about seven to seven-and-a-half times as much coal to maintain current for open circuit as for the closed circuit type, because, during the idle period of the day, approximately seven to eight times as many dynamos and engines have to be run, and the principal losses occur in these eldments instead of in the transformers. During the remainder of the day, about one-half of the time, that is, a quarter of a complete day, the efficiencies of the systems employing these two types would be equal; and during the remaining quarter of the day the efficiency of the open type would be 5 per cent. greater.

I therefore dispute Mr. Swinburne's statement that an open circuit transformer is as efficient an element of a system of distribution as its American brother. With higher frequency the open circuit transformer will make a better showing, and probably will be used, providing we can arrange means to obviate the extra losses.

By the way, why use the words converter or transformer? Would not Cyclotrope or Ergotrope, meaning that which transfers from a circuit, and that which transfers energy, be more appropriate?

WANTS TO BE THE FIRST SUBSCRIBER.

Toronto, Nov. 25th, 1890.

Editor Electrical, Mechanical and Milling News.

Dear Sir,—Having learned that you are about to make some changes in your paper, and that you intend to devote your entire space to electricity and steam engineering, I hope such is the fact, and that we may be able to say we have a Canadian publication treating directly on these matters. I think I may say for the greater part of the engineers of Canada that they will endorse and support such a paper. Count me in as the first subscriber.

Yours fraternally,

A. M. Wickens.

SPARKS.

The town of Napanee has arranged with the Bell Telephone Co. for an electric fire alarm.

The Bell Telephone Co. are making extensive improvements in their system in Kingston. Mr. T. Wadlands has charge of the work.

It is said that 13 per cent. premium was offered for some new shares of its stocks which the Quebec and Levis Electric Light Company lately placed in the local market.

It is understood that owing to ill-health, Mr. E. O. Jones has resigned his position as Vice-President of the Ball E. L. Co., Toronto, and will go south for a time.

The boiler in McDonald's sash factory at Fergus, Ont., exploded recently. Pieces thereof and boards from the roof of the building were driven through the air in all directions, but luckily no one seems to have been killed.

A quick piece of cable service is reported from Montreal. A cablegram was sent from that city over the commercial cable to London at 10.27, and at 10.40, just thirteen minutes, a reply was received. The message had been sent from Montreal to Canso, thence to Ireland, and on to London. A transaction was effected on the London Stock Exchange, and the reply was written, sent, and received in the time named.

The Winnipeg Electrical Railway is completed and will go into operation at once. The electric motor car—the first ever brought into the Canadian Northwest—was constructed at St. Catharines, Ont. The company regard this line somewhat in the light of an experiment, but they little doubt that the motor will stand the cold of winter, which a few have been inclined to question. Providing the experiment proves entirely satisfactory there is every reason to believe that the company, having a prior right, will be granted permission by the City Council to extend their system to the main thoroughfares.

A simple method of removing magnetism from watches consists in the use of a compound horseshoe magnet placed with its poles upward, and a support about three feet above it. From this support the watch to be demagnetized is suspended in a cardboard tray which hangs by a twisted thread. As the end untwists the watch is gradually removed from the magnetic field. This is much handier than the ordinary way of demagnetizing watches, which entails the use of an electro-magnet energized from a battery or other source of current, or the employment of permanent horseshoe magnets.

The electric lighting company of Concord, is using a device by means of which, it is stated, a saving of 30 per cent. is effected in the cost of arc lamp carbons. The trimmers bring to the station all the short pieces of carbon collected on their daily rounds. These are sorted and matched together, to form a carbon about eight inches in length. These pieces are placed in a machine which forms a dowel on one piece and a socket in the other, and they are cemented at the joints. The cement with which they are joined is heat-proof and is a good conductor, so that there is no change in light indicated when the joint is reached. The spliced carbons are used only in the lower holder. Carbons thus joined have been used by the company for over a year, and the process is considered entirely successful.

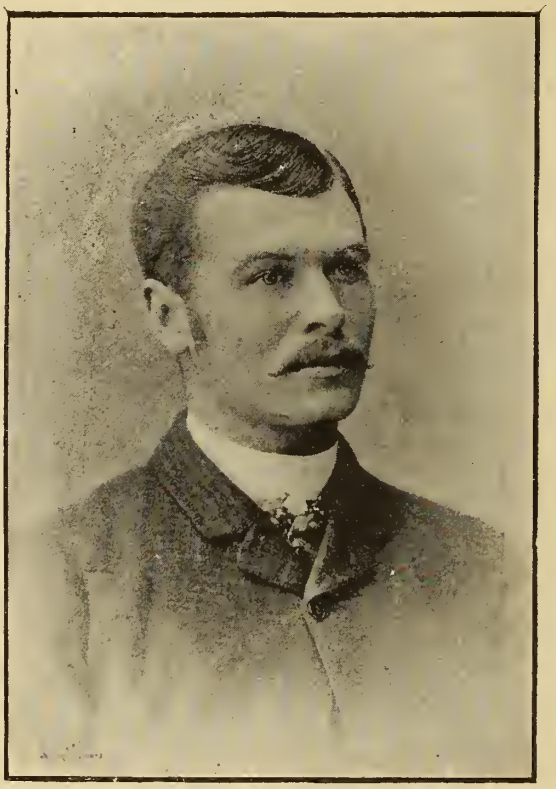
A despatch from St. Catharines says a by-law to allow the Reliance Electric Light Company to erect poles and string wires in the city of St. Catharines in opposition to the present existing company was passed Monday night, the mayor being called upon to exercise his franchise, the vote at the third reading being a tie. The stockholders of the St. Catharines Electric Light Company at present in existence are all prominent citizens, and considerable feeling has been fomenting in the triangular fight between the two electric companies and the gas company. The last named company have been laying new mains. The St. Catharines Electric Light Company have purchased a 600 Thomson-Houston dynamo, and the Reliance are offering lights at 20 cents each per night, against the St. Catharines company's 30 cents each per night. In the meantime the city is blowing out the gas, and is almost asphyxiated with the clamoring vituperations of the ratepayers.

MR. A. E. EDKINS.

We have pleasure in presenting to our readers the accompanying portrait of Mr. A. E. Edkins, President of Toronto Branch No. 1 of the Canadian Association of Stationary Engineers. Mr. Edkins, who is about 30 years old, was born in Birmingham, England, where he received an ordinary common school education. At the age of 16 he was apprenticed to the machinist's trade with Messrs. Part & Co., of Lancashire. After remaining with this firm about three years, he came to Canada, and was engaged by Messrs. Manning & Macdonald, who placed him in charge of machinery and plant used in the construction of public works. In this capacity he remained four years. He had charge of the electric plant during the construction of the Lachine Bridge, near Montreal, and on its completion was drafted into the service of the C. P. R.

About three years ago Mr. Edkins came to Toronto and entered the service of Messrs. A. Jardine & Co., as engineer-in-charge. On the termination of his agreement with this firm a year ago, he took the management of the steam and electric plant of Messrs. T. Eaton & Co., where he may be found at present.

Mr. Edkins is a young man of excellent character and ability, whose zeal for the advancement of the interests of the Toronto branch of the Canadian Association of Stationary Engineers has resulted in placing him in the positions of Secretary, Vice-President, and finally President of that organization.



Mr. A. E. Edkins.

THOUGHTS ON ELECTRIC UNITS.

In mechanical work we use quite a variety of units for measurement, and these units are quite well understood by most intelligent mechanics. Electric measurements are mechanical, and the units adopted are directly related to the mechanical units with which we are familiar. The variations are in sizes of the units and their names. The reasons for adopting new units for electric work are similar to those which induce us to measure coal by the ton, butter by the pound, gold by the pennyweight, diamonds by the carat. We understand that the carat is a certain small part of a ton, but we do not care enough about this relationship to learn what part of a ton a carat is. The human mind has a better idea of the "fitness of things" than to measure diamonds by the same units as we do coal. Therefore when scientific men were called upon to establish units for electric measurements, they sought such sizes as the force demanded, and then worked to establish accurately some standards to represent the units adopted. As these units were new they required new names, and what better course could have been adopted than to apply the names of those men who had taught the world so much of electricity as to make a need for these new units of measurement?

An electrician knows that his units are certain small parts of the common mechanical units, but he dosen't think of this relationship, except in those calculations, involving horse power parlance, any more than the diamond dealer thinks of the relation between the carat and the ton. The units mostly in use are the ohm, the volt and the ampere.

We know that any conductor offers resistance to the passage of electricity, just as we know that pipes offer resistance to the passage of water, and a unit was established for measuring this resistance. It was called an ohm, in honor of the German mathematician who originated the simple formula so much used by electricians.

A unit was established to measure the force which "pushes" electricity through conductors. It is called a volt, in honor of Volta, the great Italian electrician. We have two units for expressing the force which pushes water forward, used according to circumstances. If the water is flowing through pipe systems like city water works we use the "pound" to measure the pressure, but if flowing down streams, as used for water power, we use the "foot of head" as the unit.

A unit of quantity was also established, and was called an ampere in honor of a famous French electrician. There are many other units in use by electricians, but the three mentioned are those most in use, and a full understanding of these is of vast importance to the mechanic. When the uses of these units are well understood it then becomes easy to appreciate the others that have been adopted, but are much less frequently used.

These three units are directly related to one another. The ampere, for instance, is the quantity of electricity which would be forced through a conductor which had a resistance of one ohm by an electric pressure of one volt. To know the work to be done by an electric current we must know both the force and the quantity, which is the same as we require in water power calculations. To say, for instance, that 1,000,000 gallons of water pass a certain place in one day would not convey any idea of the power to be obtained therefrom. The hydraulic engineer must know the number of feet fall that he could obtain for this water. Tell this engineer that you have 1,000,000 gallons per day with a drop of 20 feet, and he could very soon tell you the horse power it would give. So also with electricity; to say that we have 10 amperes would give the electrician no idea of the work that could be done by the current. He must know the force behind it. If, however, you say that you have 19 amperes and a force of 100 volts he could very soon calculate the amount of horse power obtainable, and he could also tell what could be accomplished with this current in the various ways in which it is used.

The ampere is in reality the measurement of the rate of flow, so to speak, of the electric current, and it does not really give an idea of the quantity passing, because for this we need also to specify the time. Perhaps the best comparison is that of a trotting horse. To say that a horse passes us at a 2:40 pace would give us no idea how far he travels, but to say that he travels at a 2:40 pace for 2 minutes and 40 seconds would give us the idea that he had travelled just one mile. Using the second as a unit of time, then if we have one ampere for one second we have in reality a unit of quantity, and electricians have called this coulombe. This term has not come into general use, however, and another unit of quantity has been adopted in practical work. In this case the hour is used for the unit of time, and to express this unit we simply connect the two terms by a hyphen, viz., ampere-hour, and this is the unit used for most electric meters. Unfortunately this unit conveys no idea of the work that can be done by the current. For instance, one ampere-hour of electricity, with pressure of 50 volts, would only be worth one-half as much as one ampere-hour with 100 volts, and if an electric light company furnishing electricity with a pressure of 50 volts should charge the same price per ampere-hour as another company supplying electricity at 100 volts, the former would be receiving twice the rental of the latter. This difficulty has given rise to the practice of registering the work in lamp hours when used for lighting, and the most satisfactory meters to the public are those which indicate the work in this

way. In these cases the 16-candle power lamp is used for the standard.

There are two methods of distributing electricity in practical work, one in which the current is kept constant and the force is varied according to the amount of work to be done; the other in which the force is kept constant and the quantity is varied in proportion to the work done. Suppose we had at the top of a hill a supply of water which we wish to use for power, and suppose that on one side of this hill we could descend into a valley in the depth of 100 feet, and on the other side we could only descend 10 feet, and suppose, furthermore, that we wished to operate ten water wheels from this water power. If we put these ten wheels side by side and connect them by a pipe large enough to supply them all, the pressure of the water would remain constant and the quantity flowing would depend upon the number of water wheels working; or, in other words, upon the amount of work done. On the other hand, supposing we put these wheels on the other side of the hill, one wheel below the other, ten feet apart, and connect them with a pipe one after the other. To make this comparison complete it must be considered that each wheel is on a shelf or terrace in so far as the pipe is not in a straight line up and down the hill, and because each wheel is supposed to require a head of 10 feet only. Now, in this case the quantity of water passing remains constant, whereas the pressure or total drop can be considered as practically proportional to the number of wheels working. To operate all ten wheels on this system requires a total fall of 100 feet, and the same water works all the wheels; whereas, to work the ten wheels by the other system requires a fall of only 10 feet, but each wheel takes its own separate supply of water. Although this comparison is a little difficult, it is essentially the same as the two methods of distributing power by electricity. If, for instance, we have ten lamps, each of which requires a current of 10 amperes in quantity with a pressure of 10 volts, and we connect these lamps one after the other, then the same current of 10 amperes would work all the lamps, but the force would be 10 times 10 volts, or 100 volts, whereas if we connect these lamps side by side, then each would require its own supply of electricity, the same pressure would work them all, but it would require 10 times as much electricity to supply them.—*Electrical Industries.*

THE WORK THAT IS IN STEAM.

THERE is only a certain amount of work that can be got out of steam, no more, says a writer in *Power and Transmission*, and without expansion there is much less than there is with. It would be well for us to be able to figure out just how much heat and work there are in steam at any desired pressure, both with and without expansion.

The maximum work that can be got out of steam without expansion may be found by multiplying 144 by the pressure in lbs. per square inch in vacuum and by the volume of steam at the desired pressure, as compared with that of water at the maximum density of 39° F.; then dividing by the heat units per cubic foot of steam from 32° to the desired temperature, and by the volume of steam of the corresponding temperature compared with that of water at the maximum density of 39° F. (This volume is got by Fairbairn & Tate's formula:

$$V = 25.02 + \frac{49513}{I + 0.72};$$

in which V represents the volume due to the temperature and I is the total steam pressure in inches of mercury).

Suppose that we wish to know how much maximum work there is in steam at 60 pounds above vacuum, or rather more than 45 pounds per square inch by the gauge. That maximum work will be

$$\frac{144 \times 60 \times (428.32 - 1)}{170.58 \times 428.32} = (144 \times 60 \times 427.32) \div (170.58 \times 428.32)$$

equals say 50.5 foot lbs., or $50.5 \div 772 = 6.54$ per cent. of the total power.

Suppose that we increase the steam pressure to 120 pounds total, or pounds above vacuum, then we shall have the maximum amount of work

$144 \times 120 \times (227.56 - 1) = 144 \times 120 \times 226.325.20 \times 227.56$

$56) \div (325.20 \times 227.56) = 52.9$ foot pounds, about 6.85 per cent. of the total work. Thus by doubling the steam pressure above vacuum we have increased the maximum amount of work about 5½ per cent.

When it comes to figuring out the maximum amount of work which can be realized per heat unit in steam with expansion, we must multiply 144 by the total pressure in pounds per square inch, by the volume compared with that of water of maximum density, and by 2.31 times the logarithm of the stroke of the piston, divided by the period of full steam, plus 1; and divide this by the same elements as before, the heat units per cubic foot of steam from 32° to the temperature of the steam used—and the volume of the steam compared with that of water at 39° Fah.

This is a very "long-winded" rule and is much better expressed by a formula:

$$K = \frac{144P(V-1)\,(2.31 \log. \frac{S}{l} + 1)}{H\ V}$$

Instead of 2.31 times the logarithm of the relation between full stroke and the time of full steam, the expression "hyperbolic logarithm" may be used.

To work out a couple of examples under this rule and formula: Suppose that we have steam as before of 60 pounds pressure above vacuum or about 45 pounds by the gauge; and that the cut off is at ¼ the stroke. Leaving out clearance and all other disturbing and complicating causes, we get the following:

$V - 1 = 427.32$

1 + hyperbolic logarithm of $4 = 2.38629$

$H = 170.58$. Then we have

$$\frac{144 \times 60 \times 427.32 \times 2.38629}{170.58 \times 428.32} = 120.58$$

which is, of course, just 2.38629 times the result that we got with steam at 60 pounds and no expansion.

Now, trying steam at 120 pounds pressure above vacuum, we have

$$\frac{144 \times 120 \times 226.56 \times 2.38629}{325.20 \times 227.56} = 126.2$$

or, of course just 3.38629 times the proportion where there was no expansion but the same pressure above vacuum.

Now we will try cutting off at ⅛ instead of at ¼. The expansion ratio is 8, the hyperbolic logarithm of which is 2.0794, so that we shall have with eight-fold expansion, 3.0794 times the duty that we had without any expansion.

We may compare these six results with advantage:

	Proportion of work Realized.	
	60 lbs. Pres.	120 lbs. Pres.
No expansion at all	6.5	6.8
Four-fold expansion	15.6	16.3
Eight-fold expansion	20.1	21.1

HEATING FEED-WATER.

THERE is something very remarkable in the slowness with which steam users recognize the great saving they may make in their weekly coal bill by the use of feed-water heaters. In many places the gain, which might be secured at no very great outlay, would make all the difference between a dividend and no dividend. At a meeting of a paper manufacturing company a short time since, it was mentioned that this one firm used 200 tons of coal per week, and that the recent increase in the price of coal made an increase of £2,600 per year in the fuel bill, which made a reduction of 4 per cent. in the dividend, or from 12 to 8 per cent. This is only one of many works whereat such large quantities of fuel are consumed, and it is well-known to engineers that it is the exception rather than the rule to heat the feed-water on its way to the boilers. Yet by this means some firms are making a saving which represents a large income. A very moderate estimate of the value of a heater which raises the feed-water from a normal temperature to about 200 degrees, is the saving of 10 per cent. of the fuel used. This, where coal costs a £1 per ton, and where, as in the above case, 220 tons per week are used, represents a yearly saving of £1,250 per year; or probably a dividend of from 50 per cent. to 60 per cent. per year on the capital expended on the feed-water heaters.—*The Engineer.*

In the recent technological examination in England, in which scholars compete, it is a sign of the times that electric lighting attracted more than twice as many as telegraphy.

TORONTO ELECTRIC LIGHT COMPANY.

The above company was incorporated on the 25th day of September, 1883, but since then its constitution has undergone several important changes.

The present officers of the company are: Mr. A. H. Campbell, President; W. H. Howland, Vice-President; Samuel Trees, Treasurer; H. M. Pellatt, Secretary, and J. J. Wright, Manager, with a board of nine directors, viz: Hugh Blain, A. H. Campbell, W. H. Howland, John Leys, S. F. McKinnon, H. M. Pellatt, Samuel Trees, F. B. Polson, and Thomas Walmsley.

The first year the company commenced by making a number of commercial lights for use in hotels and larger business houses, and the year following supplied the street lights for Yonge, King and part of Queen streets. To-day they are illuminating all the principal streets in the city, and in some cases beyond its limits. The company claim to have the most efficient electric plant in Canada, and they certainly possess the finest and most powerful engines in the city of Toronto. The original plant of the company, consisting of Excelsior and Thomson-Houston dynamos, was erected in a building on Sherbourne street, but it was found hat larger premises would be required. Consequently the present site on the water front at the foot of Scott street was purchased, and many important new features added to the works. The company manufacture all their own plant, having every facility for constructing their own machinery, dynamos and lamps, according to the latest and most approved practice.



On the north side of the boiler house there are six 100 h. p. boilers built by the Polson Iron Works Co., and on the south side seven more of a similar capacity, one of which is opened and cleaned out each day in turn. The consumption of coal varies very much at this season of the year, depending upon the number of lights in use, the average being from 20 to 25 tons per day. At the east side of the boiler house is the smoke stack, a pile of masonry towering 110 feet high, the inside diameter of which is five feet. The chimney, boiler, and engine houses all stand on very deep, solid foundations built upon piles driven down 25 feet to the rock. A little farther south is the machine shop, in which about 25 men are employed as blacksmiths, machinists and carpenters. Here there are various kinds of lathes, milling machines, planers, drills, screwing machines, rack and gear cutters, and other special machinery used in the construction of dynamos and lamps. Work has here been commenced on the materials, including junction boxes, manholes, etc., with which to construct a system of underground iron conduit, but this work cannot be carried on to any great extent at present owing to insufficient accommodation, and on account of the increased demand for city lighting under the new contract. In order to meet these requirements the company are extending the docks out into the bay as far as the "new windmill line," so as to provide room for the erection of additional workshops.

In an upper room over the machine shops is a special new feature of the construction department—braiding and winding machines, which are used for insulating the copper wire. There are several men and boys employed at this work, and in scrapping the old braiding off wire that has been in use and requires re-insulating.

The engine house is a spacious one, and contains two pairs of high pressure condensing engines of 500 h. p. each, and two pairs of compound condensing engines of 500 h. p. each. These engines are of the Brown-Corliss type, and were manufactured by the Polson Iron Works, of Toronto, their flywheels measuring 15 feet in diameter and weighing over 10 tons each; there are four belts on these flywheels, each measuring 110 feet in length by 38 inches in width, supplied by Messrs. F. E. Dixon & Co., of this city. In the same room are three Worthington steam pumps for feeding the boilers and for fire purposes. The steam and vacuum gauges and other indicators are all mounted on an ornamental board in the centre of the engine house, so that the engineer in charge can observe at a glance the condition of the various engines in operation. Everything is kept in the best of order, being a pleasant and interesting sight for anyone to witness, and reflecting the greatest credit on those employed there.

The shafting house is on the same floor as the engine house, but is divided by a partition. From this room the tremendous power of these gigantic engines is transmitted to the dynamos on the floor above. In this room there is also a 50 h. p. engine which generates the electricity for lighting the works.

In the dynamo room there are 48 dynamos, each having an average capacity of 35 lights, and nearly all of which have been manufactured on the premises. There are at present in the city over 1,000 electric lights, and the new contract calls for nearly 500 more. At the north-end of this room is located a switch-board by means of which connections are made between the dynamos and the circuits. At the back of this room, and alongside the offices, is another large room in which is being erected a new pair of compound engines of 500 h. p., to meet the increased demand for lights which will come in operation at the beginning of the new year. In the office there is a switch-board for testing the various circuits during the day or at night when in operation. The lines are tested every few hours during the day, so that all crosses, grounds or breaks are discovered and remedied at once. The outside plant covering the city consists of over 250 miles of copper wire.

The company have a system of telegraphy for the use of the patrol and linemen at their various stations in different parts of the city. By means of these facilities constant communication can be made between the men at their stations and the works. The company's old contract with the city of Toronto expired with the year 1890, and a new one for 5 years goes into operation immediately.

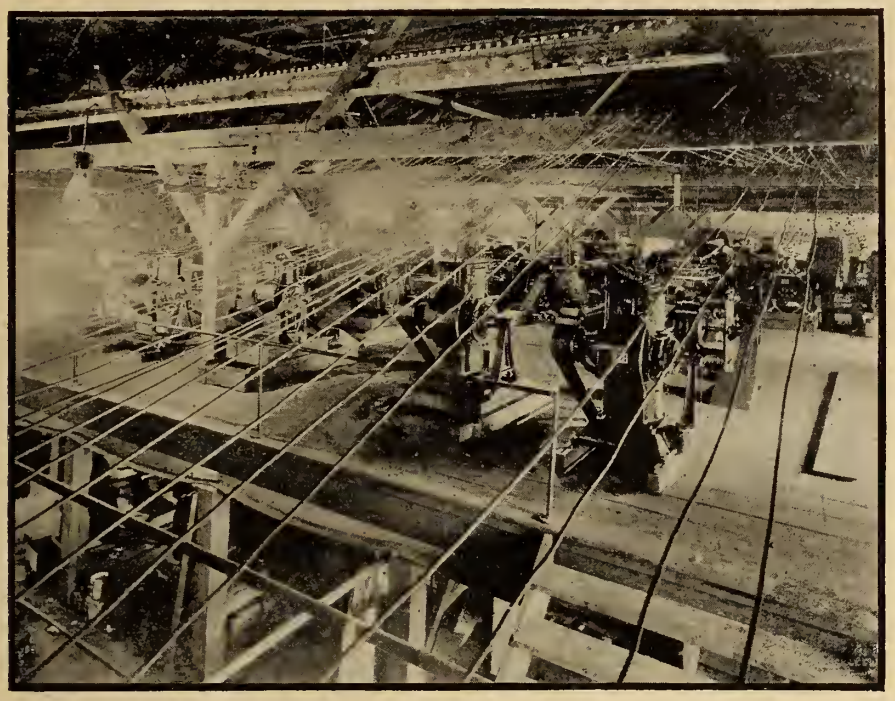
PUBLICATIONS.

The publishers of "The Electrician" Electrical Trades Directory and Hand-Book, Salisbury Court, Fleet street, London, E.C., inform us that the edition for 1891 of this carefully compiled and valuable budget of information will shortly make its appearance.

A Buffalo despatch of December 8th says the Brush Electric Company has recovered judgment for $412 against the Hamilton Ont., Electric Light Company and R. M. Wanzer & Co., in the Supreme Court, being for the same cause of action on which judgment had already been obtained in a Canadian court.

A NOVEL FORM OF MEASURING INSTRUMENT.

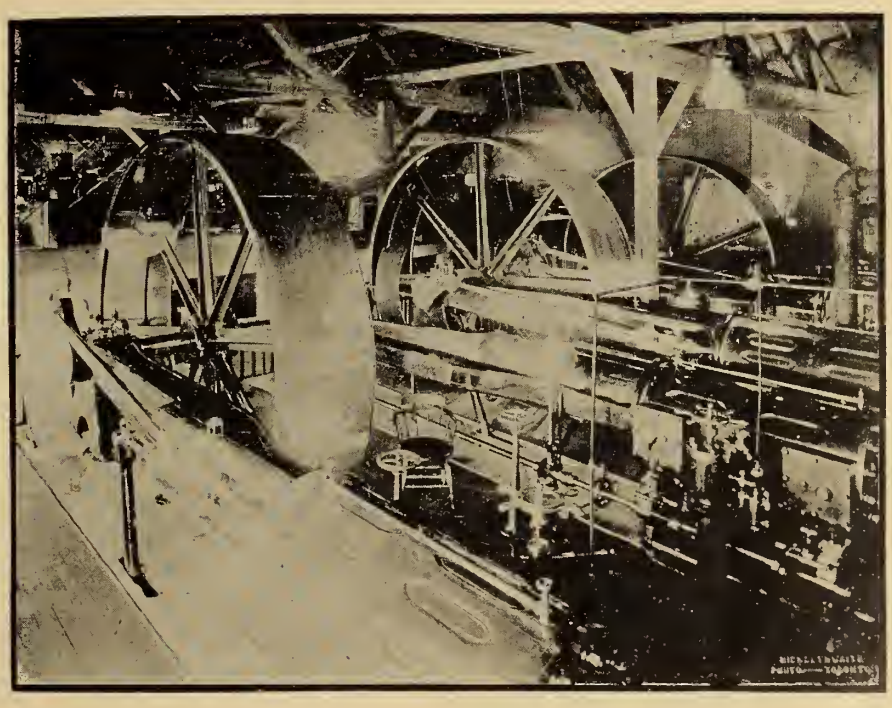
In a recent issue of *La Lumiere Electrique*, M. F. Leconte gives a brief account of some experiments carried out by him at the Liege University with a view of testing a curious form of electrical measuring instrument. M. Leconte's idea is to make a pile of circular iron discs, interposing some springy substance, between each disc, and to place this pile inside a solenoid. When the solenoid is traversed by a current, the pile of discs tends to contract owing to the formation of unlike magnetic poles at the opposing surfaces of the discs. This contraction is resisted by the springs, and by means of a suitable magnifying device the movement of a pointer along a suitably graduated scale enables one to read off the volts or the amperes. M. Leconte employed discs ranging in number from 18 to 60, in diameter (1 mm. = 40 mils) from 20 mm. to 65mm., and in thickness from .2mm. to 8mm. Some of the substances employed as springs were watch-spring steel, blotting paper, packing paper, ordinary paper, flannel and black indiarubber. The tendency of the discs to move sideways was checked by punching holes through them and slipping them over vertical glass rods. The sensitiveness of such an apparatus can be increased either by adding to the number of the discs, augmenting their surface, or by providing the solenoid with a core of iron wire. M. Leconte gives curves of the scale readings obtained with a voltmeter arranged with 18 cast-iron discs, 8mm. thick, and 65m. in diameter, and provided first with indiarubber springs and then with steel springs. The curve in the first case was fairly regular between 27 and 53 volts, with steel springs the curve was very irregular, with indiarubber springs the deviation of the scale index was only 18mm. for 57 volts, and the actual contraction of the column of discs was only 2mm.; with steel springs the index deviation was only 8mm. for 50 volts.



Toronto Electric Light Company—View of Dynamo Room.

THE LUBRICATION OF STEAM ENGINES.

The following is extracted from an interesting article on this subject which appeared in a recent issue of the *Engineer:* Engineers very commonly pay scant attention to the cost of oil used in lubricating steam engines. They regard it as an insignificant item. Even those who pay for the oil take small pains to ascertain whether they are paying more than need be paid. The results of an inquiry into the question of oil bills in any district would, we venture to say, give highly startling results. Not long since we were shown an American engine of the horizontal high speed type. It was indicating about 13 or 14 horse-power. Coal was very cheap, and we were told that the cost of fuel was as nearly as might be 1s. 6d. per day. The oil bill was 3s. 6d. a day, or more than twice the cost of coal. In another instance we found an engine indicating about 1,500 horse power and using 120 gallons of oil per week. Again we find in some cases that oil costing 2s. 6d. per gallon is used; in others, for just the same class of work, about 9d. a gallon is paid. It will readily be seen that a lavish use of oil at 2s. a gallon runs into a great deal of money. It is high time, we think, that more attention was given to this subject than has hitherto been devoted to it by users of steam machinery. The chief causes of excessive oil consumption are—says our contemporary—firstly, that engineers or drivers in charge of engines care nothing about oil waste; secondly, badly designed or badly kept engines; thirdly, unsuitable oil; fourthly, running in dusty places; fifthly, defective lubricating apparatus.



Toronto Electric Light Company—View of Engine Room.

The G.T.R. Co. have recently commenced to heat their Lachine train with steam from the locomotive.

Messrs Phippen & Graham, Belleville, intend compounding the engine of the steam barge Saxon and putting it into a new hull, to be built at Pictou at a cost of 22,000.

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EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

SALUTATORY.

THE general character of this journal, as well as the objects which it will seek to promote, will to a large extent be revealed by an examination of this first number. We are consequently under obligations to say but little by way of preface. The electrical industry is one of great importance in Canada, the installations at present numbering between four and five hundred, and electric lighting and power plants being daily installed in every part of the country. They may shortly be found in almost every manufactory, and in every large building. Side by side with them will be the steam engine and boiler, from which must come the power to generate the electricity, and furnish steam for heating. Upon the steam engineer will devolve the duty of operating the electric as well as the steam apparatus. It is because electricity and steam are destined thus in future to be so closely allied, that we are led to hope for the complete success of the paper in its new form. We are strengthened in this opinion by the hearty assurances of support which have already come to us from the various electrical companies, and from officers and members of the Canadian Association of Stationary Engineers.

Arrangements have been made whereby gentlemen recognized in Canada as authorities on the subjects of electrical and steam engineering will contribute liberally to the pages of each number.

Recognizing how many persons there are in charge of electric plants at the present time who have had little opportunity of gaining a proper knowledge of the principles of the science and their application, a special effort will be made to supply such information. It will be seen that in the present number has been commenced a series of articles giving the primary data with which the student needs to be thoroughly familiar before he attempts to acquire the higher standards of knowledge. To those who may happily have got beyond the rudimentary stages, it may seem like beginning too low down the scale to print information of this character, but we believe that to the majority of persons operating electric plants in Canada to-day it will prove welcome and helpful. It was thought well to begin thus at the very foundation, and after having placed the student in possession of a knowledge of the underlying principles, to lead him from thence onward to higher attainment. In view of this purpose, the persons into whose hands this paper may come, and who may be in need of this class of information would do well to become subscribers at once and thus secure possession of the entire series of articles.

In endeavoring to educate those charged with the operation of electric apparatus, we shall be conferring benefit also on the owners, inasmuch as upon the knowledge and consequent efficiency of the operator depends to a large extent the dividend which an electric plant may be made to render. It is safe to say that some of the plants in Canada to-day are not yielding a fair profit to the owners because the persons in charge are unable through lack of knowledge to obtain from them the highest efficiency of which they are capable at the least cost.

A Canadian Electrical Association, where owners and operators of electric apparatus might meet and consider the many questions affecting their interests, is a present necessity, and no effort will be spared on the part of this journal to bring about its early formation.

The Canadian Association of Stationary Engineers we believe to have been founded on right lines, and to be doing a grand work in the direction of raising the standard of efficiency not only of its members, but of engineers generally. It must be acknowledged that there is great necessity for a higher average qualification than that which at present exists. With the increasing number of steam plants coming into use in connection with the heating and lighting of large buildings, the danger to life from improper management is vastly greater than ever before, hence the greater necessity for fully competent engineers.

Many persons operating steam engines have as yet refrained from connecting themselves with the Association. We hope to see the number speedily grow less, as we believe such persons would best promote their own interests by joining the Association and assisting to bring about the objects sought to be attained.

In conclusion, the columns of this journal will be at all times open for the expression of opinions of its readers on any subject relating to electricity and steam engineering. Correspondents will be expected to observe brevity of expression, and avoid personalities. As far as we are able, we shall be pleased to answer questions on any subject which may legitimately come within the scope of this journal.

A NOTEWORTHY result of the rapid introduction of electricity in its various forms of light and power is the high standard of knowledge and intelligence required of the mechanical engineer. Formerly any man or boy who knew enough to throw on coal and sling a pot of hot tallow was considered abundantly competent to "run the engine," and as long as the engine "ran" with tolerable punctuality he was doing about all that could be reasonably expected of him. The evolution from this state of things has been almost as rapid as the introduction of electricity itself. Hand in hand with the progress of electrical development has gone the improvement of the steam engine, and machines are placed in the hands of the engineer of to-day comprising a complexity of mechanism and employing a pressure of steam such as his predecessor of the tallow pot could have had no conception of. This alone would call for a higher intelligence and greater skill on the part of the manipulator, but the fact that the forces of steam and electricity have become so allied and interwoven—one depending so much on the other—would indicate that something even more than this will be required of the modern engineer. Every factory in which steam power is employed to any extent now has, or will have, its electrical plant for lighting and for the transmission of power, so that it has become necessary that he should understand at least some of the principles of dynamo-electric construction and operation, and have some knowledge of the laws which govern the production and distribution of electric currents. The introduction of high-pressure steam with the principle of expansion carried to its utmost limit requires an amount of theroetical and practical knowledge heretofore not considered essential, so that for the thoroughly capable and aspiring engineer who is able to grasp all this, and besides has a sound practical knowledge of electricity, there is a constantly widening field. In isolated plants there is a demand for him. Central stations for the distribution of power and light are increasing in number and extending their operations, and the extension of electric railway systems will in the near future offer unexampled opportunities. In this, as in other walks of life, the best men will rise to the top, and the painstaking, intelligent and careful engineer will rank amongst society's most useful and respected members.

THE cost of electric apparatus to-day is very much below what it was five, three, or even two years ago. This is due in part to the growth of competition amongst manufacturers, and in part also to the discovery of improved methods of manufacture. Whether or not cheapness has in any measure been attained at the expense of quality, we are not in a position to say. The purpose is simply to point out the disadvantagous position in which the owners of plants purchased a few years ago now find themselves as the result of the fall in values. It is demanded of them that their prices shall correspond with those prevailing in neighboring towns, where the plant was bought for a much less sum, and where, consequently, a smaller revenue will suffice to meet interest charges and return a fair dividend. To this cause is attributable the fact that so large a proportion of central station plants are being operated with little profit. Another important factor in the way of dividend earning, is the absence of economy in operation of electrical circuits, due to lack of properly qualified superintendents. The ELECTRICAL NEWS will do what it can to place in the hands of those in charge of electrical plants, information which will assist them to obtain the highest degree of efficiency at the smallest cost.

THE year just closed has been a busy one for the electrical industries of Canada. It has been marked by a large increase in the introduction of isolated installations in private factories and steamships, and extension in the plant of every central station of any size in the Dominion. The city of Montreal led the way in the exclusive adoption of electric lighting for its streets and squares. The Royal Electric Company there have built extra stations of immense power, and have kept their factory busy on plant for these extensions for a year past. besides a large amount of construction work in isolated installations, notable among these being the passenger steamships of the Allan Line. Quebec has extended its service by the introduction of large incandescent machines on the alternating principle, driven like their predecessors by the power of Montmorency Falls fourteen miles away. In Toronto the progress has been most marked, the city having closed a contract for five years for an additional illuminating capacity of 400 lights. The shops of the Toronto Electric Light Company have been in full operation, night and day, for months past, constructing the necessary machinery for this extra work, and the engine and boiler industry in the city has received an immense impetus in satisfying the demands for more power. A new station has been started in the city for the supplying of incandescent light on the Edison system by means af underground wires, and the local construction companies have been busy keeping up with the demands of their stations in all parts of the city, besides installing a considerable number of new ones in public institutions and for private customers. The present year promises to eclipse all previous records in electrical construction. Many public institutions have under contemplation the introduction of electric plant. Central stations must try to get ahead of the demand for light which they are now unable to satisfactorily meet, and the distribution of electric power is as yet almost untouched. The contemplated introduction on a large scale of electricity for street railway purposes and a large amount of underground work by telephone and telegraph companies will combine to make the year as busy a one as any we have known. The industry of carbon making, though an infant one, is giving promise of a sturdy growth, and the manufacture of insulators and globes is becoming a well established and profitable branch of the glass making industry. Altogether we look for a prosperous year. That it may prove so is our earnest wish, and to make it a matter of record we hope may be the agreeable province of the ELECTRICAL NEWS.

THAT the schoolmaster is abroad is evident from an article which appeared in a Toronto evening paper under the heading of "A feasible scheme." It is there suggested that the proposed gravitation plan for supplying the city with water should also include its utilization on its way down from Lake Simcoe to produce power for the generation of electricity and other purposes. So far this is perfectly "feasible," but when the promoters gravely propose as a result of using this power "to put an electric light on top of every lamp post, to run all the street cars in the city, and supply power to an unlimited extent for manufacturing purposes" they are letting their brilliant imaginations get a long way ahead of their knowledge. A few figures will demonstrate this. The estimated consumption of water in Toronto is now about fifteen million gallons per day. Sixty millions per day is figured as the amount that can be made available, and as sufficient for the city's needs for many years to come. The utmost fall that could be obtained even in sections all along the line of conduit would not exceed 250 feet. Sixty millions per day would be 42,000 gallons per minute. This multiplied by 10, the number of pounds per gallon, and by 250, the height in feet, and divided by 33,000, the number of foot pounds representing one horse power, would give a sum total of 3,100 h.p. The loss in transmitting this at a tension suitable for electric power and railroad work would be at least 50 per cent., while the interest on the expense of copper conductors would amount to nearly as much as fuel for a steam engine on the spot. There is over 1,500 horse power now used in the city for the electric lights alone at present in use, to say nothing of "the top of every gas post." To the mind of the practical man the scheme is utopian in the last degree, but its promulgation and unquestioned acceptance in many quarters goes to show the need there is of a popular educator for the masses in the first rudiments of electrical and mechanical principles. Of course we cannot expect every one to be learned in the precise sciences, but now that electricity is rapidly becoming a household word, and is being utilized in so many of the operations of everyday life, it becomes a necessity that every man who desires to keep himself informed on current events should be acquainted with at least some of its first principles and economic values. Its rudiments should be taught in our schools, and periodicals bearing upon its progress should be allowed to claim at least an equal share of attention with the best on any subject from those of our mechanics, business men and citizens who aspire to become acquainted with every factor of our modern civilization.

IF ever there was a crying need for an underground conduit for electric railways that need is felt to-day. Improvement upon improvement has been made in the cars, the track, and especially in the motor and electrical outfit. Their success is a tangible and solid reality. The electric method of propulsion is practicable beyond a doubt, but the full and complete fruition of its success will not be realized until the unsightly and cumbrous overhead construction can be done away with. It would seem to the tyro a simple matter to lay a trench to contain the wires with a slot on top to enable the car to make a wiring contact with it at any point in its progress, but the fact remains that the more it is tried the more frequently and emphatically are its difficulties demonstrated. Wet, or even dampness—the arch enemy of the electrician—are fatal in the case of the open conductor such as must be employed to admit of contact with the moving motor. A perfectly insulated conductor in a closed conduit and carrying an alternating current intended to work the motor by induction has been proposed—something similar in principle to the telegraph employed on moving trains—but it is evidently a case of "the wish being the father of the thought" and we should not feel disposed to squander much wealth on the patent of the scheme. Another proposition to overcome the difficulties of a conduit and to reduce the leakage to a minimum is to employ a sectional conductor, a short length only being automatically placed in communication with the main insulated conductor while the car is upon it, and disconnected as the car leaves it and enters upon the next one ahead. The chief objection to this plan would seem to be its complexity and liability to derangement at most critical times. The storage battery is at present a forlorn hope, yet it would be idle to say it will never be made commercially available. It must, however, be radically improved before it can be. Though at present it may be a somewhat forlorn one yet we *do* hope that the storage battery will be the coming solution of the problem. The advantage of having the car carry its motive power along entirely independent of connection with anything else and able to run on any track at present constructed would be a consummation devoutly to be wished. Its success would place the electric car upon the tracks of every street railroad in the Dominion, and our larger cities which now hesitate on account of the objectionable overhead construction, would rejoice in the fulfilment of their desires. The next best method not open to so much objection would be

the conduit, providing it can be successfully accomplished. Some of the foremost of the construction companies are working at the problem with all the skill at their command. Let us hope that every success may crown the efforts of some enterprising inventor, and then the electric railroad on our busy streets would become a thing of beauty and a joy forever.

ON ERRORS IN BOILER TRIALS.

MANY engineers and experts, in making boiler trials, measure the weight of fuel, the weight of water, and the other quantities, without paying the slightest attention to the relative accuracy with which these quantities should be determined. The object of this article, from the *Locomotive*, is to show that such considerations may be of importance when a very accurate result is required.

As an illustration of the point we wish to make, let us take the following example : At a certain boiler trial the amount of coal actually burned was 2,354 pounds, and the amount of water evaporated was 20,640 pounds. These figures give ns an evaporative efficiency of 8.77 pounds of water per pound of coal.

Now let us assume that an error of 50 pounds was made in weighing the water, so that the apparent amount of water evaporated was 20,690 pounds, instead of 20,640 pounds, the actual amount. $20{,}690 \div 2{,}354 = 8.79$, so that the apparent evaporative performance of the boiler is 8.79 pounds of water per pound of coal, instead of 8.77 pounds, which is the correct result. The difference introduced by an error of fifty pounds in weighing the water, it will be seen, is only .02.

Now let us make a different supposition. Let us assume that the water was weighed correctly, but that an error of fifty pounds was made in weighing the coal, the apparent weight of coal being 2,304 pounds. Then $20{,}640 - 2{,}304 = 8.96$, so that the apparent evaporative performance of the boiler is 8.96 pounds of water per pound of coal, instead of the true result, 8.77 pounds. The difference in this case is quite appreciable, and the example shows that it makes quite a difference whether a given error is made in weighing the coal or in weighing the water.

The moral of this is, we suppose, that we should pay particular attention to the weighing of the coal. The scales should be very accurately balanced for the weight of the barrow, and the readings should be taken closely. The value of the kindlings, expressed in pounds of coal, should also be carefully ascertained. Furthermore, if we wish an accurate estimate of the evaporation per pound of *combustible*, we should be very careful about wetting down the fire after it is hauled ; for the error introduced by the weight of the moisture in the ash produces as great an effect on the result as an equal error in weighing the coal.

The ideal way of carrying out a test is to make all the measurements in such a manner that the error committed in making any one of them shall have the same effect on the result as the error committed in making any other one. The principle is the same, to use an excellent but threadbare illustration, as in making a chain. Don't make one link any stronger than any other one, for if you do you are wasting labor. This can be achieved in evaporative tests by weighing the coal with 8 or 9 times the accuracy used in weighing the water, the ordinary evaporation per pound of coal being from 8 to 9 pounds. Of course we do not mean that this should be done with any very great degree of precision, but what we do mean is that the water should be weighed with ordinary care, and the coal with ordinary care.

Another very necessary operation in testing evaporative efficiencies, is the determination of the dryness of the steam generated. The ordinary method of conducting this part of the work is described in *The Locomotive* for March, 1890, on page 35, and to this description we would refer the reader. In the place of the steelyards there shown, a spring balance of some sort is often used. This should never be done unless the spring balance is of special construction, so as to weigh very accurately. The ordinary spring balance will not weigh closer than an ounce—or, at the outside, half an ounce. The total weight of steam admitted being 16 ounces, half an ounce is one thirty-second of the whole amount, and an error of one thirty-second in the amount of steam admitted will produce approximately the same effect as an equal error in noting the rise in temperature of the water in the pail. For instance, let us suppose that a given sample of steam actually contains 3 per cent. of moisture, but that we *have* admitted 16½ ounces of steam, when we think we have admitted only 19 ounces. The error, half an ounce, is one thirty-second of the whole amount. The rise in temperature would have 102° Fah. if we had really introduced only 16 pounds ; but the real rise in temperature will be one thirty-second greater than this, since we have introduced one thirty-second more steam than we think we have. A thirty-second of 102° is 3°, which added to 102° gives 105°; and this is the *actual* rise in the temperature of the water in the pail. Thus we see that although the steam really contained 3 per cent. of moisture, the error of half an ounce in the weight of the pail would make us conclude that it was absolutely dry. The moral of this is, that there is no use in measuring the rise in the temperature of the water to within one per cent., if we are going to commit an error of at least three per cent., and perhaps six per cent., in weighing the water.

We may call attention here to another error that one is liable to, in determining the dryness of steam by the ordinary method —an error that at first sight seems quite insignificant. When the steam is still entering the pail, and the steelyards are approaching equilibrium, the easiest way to secure an accurate balance is to leave the pail in position, with the steam pipe still dipping below the surface of the water, and close the valve just at the right instant. The final weighing is thus performed with the steam-pipe submerged ; while ordinarily the ten pounds of water originally put in are weighed without the steam-pipe. For the sake of investigating the effect of this let us assume that the pipe dips 5 inches below the surface of the water, and that the area of its cross section is half a square inch. When in position, therefore, it displaces 2½ cubic inches of water, and therefore increases the weight of the pail and contents by nearly an ounce and a half. It will be seen from this, and from the previous calcalation of the effect of an error of half an ounce, that it is a highly important matter to have the steam-pipe dipping into the pail when the original ten pounds of water are weighed out. The most satisfactory way is to make a suitable mark on the pipe, and bring this mark to the level of the water in the pipe whenever a weighing is made.

VARIATIONS IN THE E. M. F. OF CELLS.*

THE description of the apparatus, the capillary electro-meter, and method of working are given fully in the paper. The following conclusions are drawn from the results of the experiments :

I. When the metals, copper, silver, bismuth and mercury, are introduced into purified nitric acid of different degrees of concentration, and a couple made with platinum, the E. M. F. of such a cell increases considerably from an initial point until it reaches a constant and in most cases a maximum value. The rise of E. M. F. is attributed to the production of nitrous acid by the decomposition of the nitric acid, and the final value is considered to be due to the former acid only, while the initial value is due for the most part to the latter acid, though it is affected to a remarkable degree by the amount of impurity of nitrous acid, either initially present or produced by minute and unavoidable uncleanliness of the metallic strip and the containing vessel.

II. If nitrous acid has been previously added to the nitric acid, then the maximum E. M. F. is reached at once.

III. If the conditions—namely, increase of temperature, of impurity, and of concentration of acid—are such as would favor a more rapid solution of the metal, and consequently a more rapid production of nitrous acid, then the rise of E. M. F. is concomitantly more rapid.

IV. Conversely, if the conditions are unfavorable to the production of nitrous acid, the rise of E. M. F. is less rapid.

V. If any substance, such as urea, be added which would tend to destroy the nitrous acid as fast as it may be formed. then the rise of E. M. F. is extremely slow, being dependent upon the number of molecular impacts of the nitrous acid upon the surface of the metal. Thus, the results obtained by the electrometer are confirmatory of those obtained by the latter author with the chemical balance.

The authors propose to carry on further investigations on kindred problems.

*Abstract of a paper on "The Variations of E. M. F. of Cells, consisting of certain Metals, Platinum and Nitric Acid," read by Messrs. G. J. Burch and V. H. Veley, University Museum, Oxford, before the Royal Society, Nov. 27th, 1890.

NOTES.

Mr. John Thomson has been appointed inspector of boilers and machinery for the province of British Columbia.

When wood is to be the fuel employed under a boiler, the grate area should be from 25 to 40 per cent larger than if coal is to be used.

The Steam Boiler and Plate Glass Insurance Co., recently organized at London, Ont., has made application to Parliament for incorporation.

Mr. Frank Doty, of the Doty Engine Co., and Mr. Reid, of the firm of Reid & Currie, Toronto, recently paid a visit to the Northwest and British Columbia.

At a recent meeting of the executive committee of the Stationary Engineers of Montreal it was decided to amalgamate with the Canadian Association of Stationary Engineers.

Much regret is felt throughout western Ontario at the recent death of Mr. Geo. Marks. of London, who for thirty-five years was a locomotive engineer on the Great Western division of the G.T.R.

The Canadian Locomotive and Engine Co., of Kingston, are building two locomotives for the Chignecto Marine Transit railway which will weigh 100 tons each, and will probably be the largest locomotives in the world.

Aluminum wire is being used for calking steam pipes in New York with good success. A wire of ¼ inch diameter is used, one turn of aluminum wire being first inserted, followed by four or five turns of a lead wire of slightly larger diameter, these last being calked in the usual manner. It is found that aluminum does not cut, and is not acted upon by the steam as the lead is, so that joints remain tight much better.

Recently experiments have been made with high pressure steam to determine its dryness, in which a match is held in the issuing jet. Where the s eam is dry the match will ignite, but any moisture will, of course, prevent it. It is an indication merely of the state of the steam issuing, which may be dry through wire drawing, while in reality wet when it leaves the boiler. Whether or not steam is wet is a matter of importance to the engineer when testing his plant. We note a number of boiler tests reported recently showing exceptionally good work in which no account was made of the moisture. It makes a great difference whether you evaporate all the water put into a boiler or send a portion of it through the engine without ever being made into steam.

Steam gauges are often placed in queer places, and, in many instances, without regard to the necessity of following certain directions in setting them up. *The Locomotive* reports finding steam gauges so arranged that their indications are necessarily a number of pounds in error, owing to the static pressure of water of condensation in the connection. While the error does not ordinarily exceed two or three pounds, it sometimes is far greater than this, and becomes of grvae importance, especially in low-pressure systems. We met with a case recently in which an ordinary heating boiler was in the basement, and the gauge was in the owner's room on the third floor, fully twenty-five feet above. The piping was so arranged that it was an easy matter for it to fill up with water condensed from steam, so that the indication of the gauge might be as much as ten pounds less than the actual pressure in the boiler. Such a gauge, it need hardly be said, is no better than none at all. In fact, it becomes a positive source of danger.

A paper was recently read before the Halifax, N.S., Institute of Science, by D. W. Robb, M.E., of Amherst, on "Steam Boiler Tests as a Means of Determining the Calorific Value of Fuels." The author said there are three methods of determining their calorific value—(1), by chemical analysis; (2), by the use of the calorimeter; (3), by direct measurement of the water, evaporated by a definite amount of fuel in a steam generator. He pointed out the difficulties and sources of error in the first two. The third is generally regarded as a test of the efficiency of the generator, but experience shows that it is quite as valuable for determining the calorific value of a fuel. In using it there are two sources of error—(1), through imperfect combustion of the fuel; (2), through escape of gases at a high temperature. Practically these errors may be largely excluded, experience showing that almost perfect combustion may be secured by careful stoking, and that the gases may be reduced to a known minimum temperature before escaping and may be made to register their volume on escaping. It is not of much consequence what kind of generator is used, a water-lined furnace being quite as good for the purpose as a brick furnace. Steam boiler tests are quite within the reach of ordinary consumers and should be more generally used. Owing to the deterioration of boilers they should be made frequently. They may be made by ordinary assistants, but an occasional test should be made by a professional engineer. The author suggested as good practice in the use of steam engines, the recording of the amount of water used by a water meter and the regular weighing of the coals consumed. Such practice would indicate constantly the condition of the boiler, would form a check on the working of the engine and would furnish a constant incentive to the men in charge to improve the working of the engine and reduce the consumption of fuel to its lowest limit. Detailed statements were given of the way in which such tests should be made and of the manner in which the results should be registered.

PERSONAL.

Mr. Rosebrugh, B.A., an honor graduate of Toronto University, and also a graduate of the School of Practical Science, Toronto, has been engaged by the management of the latter institution to give a portion of the instruction in mechanical engineering and take general charge of the testing machines, experimental engines and other testing apparatus. Mr, Rosebrugh is said to have devoted much attention to the subject of electricity.

RECENT CANADIAN PATENTS.

No. 35323. Jas. F. McElroy, Pressure regulator.
No. 35335. J. Blair, Connecting carbon pencil.
No. 35337. M. Burt, Galvanic battery.
No. 35349. T. Stettson, Insulating conductor.
No. 35358. J. P. Hebendalt, Elevating and lowering electric light.
No. 35372. W. Blakely. Engine lever and handle.
No. 35391-10. G. Weems, Moving goods by electricity.
No. 35400. G. Pfamkuche, Dynamo.
No. 35406. A. Woodbury, Air current.
No. 35438. J. Van Depoele, Pulsating electric generator.
No. 35449-20. R. Earle, Air and steam injector.
No. 35455. Jos. Van Depoele, Pulsating current system.
No. 35456. " " Conv't'g cont. into pul.
No. 35457. " " Multiple cur. pul. gen.
No. 35458. " " Alternate cu. pul. gen.
No. 35459. " " Alternating cur. elec. recip'g engine.
No. 35460. " " Recip'g cur. elec. engine system.
No. 35475. H. Dow, Rotary steam engine.
No. 35478-22. F. Leadbeater, Low water alarm.

STORAGE BATTERY STREET CARS AS A BUSINESS ENTERPRISE.

We learn from the New York *Electrical Review* that the Metropolitan Street Railroad Co., Washington, has decided to change the entire equipment of its main line from horse cars to storage battery cars. It is now building the first installment of cars and preparing to commence the erection of an extensive power station. This will be located on Rock Creek, between Washington and Georgetown, where the company some time ago purchased a large block of land adjoining its present stables. About 40 cars will be required on this line, and they will be put in operation, probably in lots of five, as fast as they can be got ready and as soon as the station is started. Engineer Mailloux's motors and gearing will be used. This part of the equipment is to be manufactured at Baltimore by Mr. G. W. S. Baker, president of the Baltimore Car Wheel Co., who has established a factory for the business. It is expected the first cars will be running in the course of three or four months. This undertaking has been decided upon after the most thorough and exhaustive investigation of the whole subject of street car propulsion and nearly a year's experimenting with Mr. Mailloux's invention and the Accumulator Co.'s batteries. President Pearson is one of the most experienced and successful street railway managers in the country, and he has satisfied himself and his stockholders that they have caught up with the "motor of the future.

TEMPERED COPPER FOR ELECTRICAL PURPOSES.

In the construction of electrical apparatus copper enters largely, and thus far nothing has been found which could, with any degree of success, be substituted for it. And not only in the construction of machines and appliances is it used, it is the material of which is composed the millions of miles of conductors for electric currents all over the world. For some purposes the ordinary, common, commercial copper is too soft, and wears away too rapidly, so to avoid this tempered copper has found its way into the market. Some recent tests of this material, made by the sub-committee on Science and the Arts, of the Franklin Institute, contain some points of interest to central station managers who are quite willing to have the best material for the commutators of their dynamos, and those who are engaged in the manufacture of electrical appliances. In this examination chemical tests were made showing the article in question to be commercially pure copper, and various tests were made—tensile, transverse, torsion, and compression of both tempered and untempered copper as well—the results generally being in favor of the former, though in some respects there is little to choose between them. Some interesting facts were brought out by letters sent by the committee to various users of tempered copper, about sixty-five per cent. of the answers being of a favorable nature: the greater part of these, too, basing their answers upon their experience with tempered copper for commutator segments and brushes. This point is of most interest to those using dynamo electric machines, and while tempered copper is no new thing it certainly possesses excellent qualities. Anything which will render the operation of dynamo machines and motors more economical is certainly of value, and will, in time, as has been the case with other new things, come into general use.—*Modern Light and Heat.*

FACTS CONCERNING DYNAMO ELECTRIC MACHINES AND THEIR MANAGEMENT.*

A dynamo consists of the field and the armature. The field consists of the magnets, which are solidly connected with the iron frame. The magnet are iron cores, on which layers of insulated wire are wound. These magnets belong to the class of electro-magnets, as they become magnetic only when the current is passing through their coils. Between the poles of the magnet the armature rotates. The armature consists of an iron or steel shaft, to which a number of coils of insulated wire are affixed.

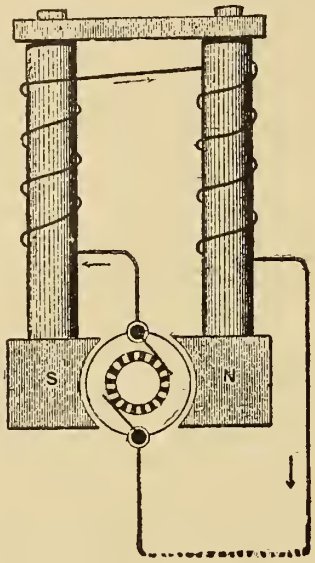


Fig. 1—The Series Dynamo.

Metal plates or bundles of wire called brushes conduct the current generated in the armature to the lamp circuit.

The two main types of dynamos are :

A, *The continuous current dynamo.* The current generated in this dynamo always flows in the same direction. The armature of this dynamo has a commutator from which the current is taken off by the brushes.

B, *The alternating current dynamo.* The current generated in this machine flows at rapid intervals first in one and then in the other direction. This dynamo has no commutator but simply a collector consisting of two metal rings on which the brushes rest. The magnets of the alternating current machine require, however, a continuous current for excitation. This current is

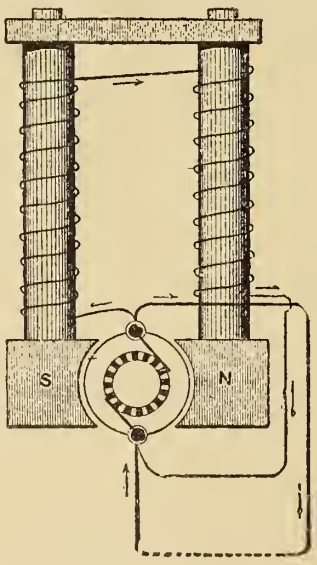


Fig. 2—The Shunt Dynamo.

generated by an extra continuous current machine of small size, which is called the exciter.

A, The series dynamo, Fig. 1. Magnet, armature and lamp circuit are connected one behind the other, that is, in series ; that is to say, the current generated in the armature passes in equal strength through field magnets and lamp circuit. These machines are mostly used for arc lighting.

B, The shunt dynamo, also called derived circuit dynamo. The coils of wire wound around the field magnets in Fig. 2, are connected in shunt or parallel to the brushes. Only a comparatively small part of the current generated in the armature is used for excitation of the field coils, while the greater part of the current is conducted from the brushes to the lamp circuit. These machines generally have a resistance box, rheostat or regulator which is connected in the shunt winding of the field. By putting

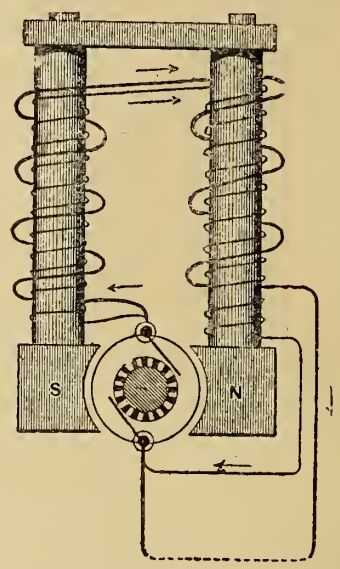


Fig. 3—The Compound Dynamo.

more or less resistance in the field of these machines the e. m. f. at the binding post of the machine can be decreased or increased. Shunt dynamos are mostly used for incandescent lighting. In some systems, however, they are used for arc lighting also.

C, *The Compound Dynamo.* This dynamo, Fig. 3, combines in its fields the winding of both the series and the shunt dynamo. The magnets are wound with thick wire, which is in series with the armature and the lamp circuit. In addition they have a winding of fine wire, which is in shunt with the brushes. This dynamo generally has a resistance box put in the shunt winding of the fields, for the same purpose as explained under *B*. Compound dynamos are mostly used for incandescent lighting.

The field wire coils of an alternating current dynamo, Fig. 4, have no connection with the brushes of the dynamo at all. The fields are separately excited, as mentioned in the foregoing, by a little continuous current dynamo, called an exciter. The alternating current machines were used formerly for arc lighting mainly—very little, however, in the United States—but recently have been introduced for long distance incandescent lighting by means of transformers or converters.

In the preparation of a new dynamo for operating, iron parts which have to be fitted to each other must be carefully cleaned

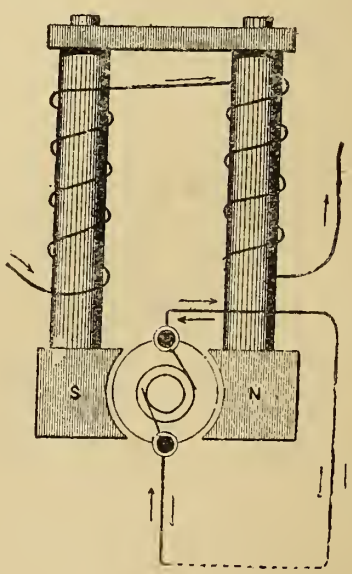


Fig. 4—The Alternating Current Dynamo.

with fine emery cloth. When the armature is put into the dynamo, extra precaution is necessary in order to avoid any injuries to the insulation of the wire and to the commutator. The armature should be carried by a man on each end of the shaft. Heavy armatures should be supported by a board put underneath the armature, and each end carried by an additional man.

* From the "Dynamo Tender's Hand-Book.

Armatures weighing over 500 pounds should be handled by means of a differential block and tackle.

An armature should not be lifted by its commutator.

Some soft material, such as cotton waste or felting, should be put between the armature and the support.

When put in place in the dynamo the armature must not touch the pole pieces and must turn easily. There should be at least from 1-16 to ⅛ inch play between its bearings. This play or lengthways motion can generally be regulated by adjusting the collar on the shaft.

It must be borne in mind that the armature will warm and expand not only diametrically but also lengthways. If there should be no play, the armature might get wedged between its two bearings and cause hot boxes and stoppage of the dynamo. A swinging motion of the armature will cause the bearing to wear evenly, distribute the oil from end to end of the bearings, and prevent heating of the boxes. An armature can be caused to play only when the dynamo is in proper alignment and the belt not too tight.

All connections through which the current has to pass should be cleaned with fine emery cloth and should not touch any part of the iron frame or field-coils of the dynamo.

It is advisable to run a new dynamo a few hours or even a day, without any load, in order to test the lubrication, etc., not only of the dynamo, but of the engine, if it should be a new one. If everything is in good condition the load should be put on gradually. This can be done, either by running the dynamo below normal speed and gradually increasing the speed, or by using the resistance boxes and starting with very little current and gradually increasing it.

The latter is especially advisable for incandescent lamp installations. The testing should be made during the day. It will require for small plants a few hours ; for plants of greater importance a few days ; only when everything operates in good order should the regular running of the installation commence.

Every day before starting the dynamo, the dynamo tender should examine the binding posts, commutator and brushes. If the brushes are allowed to rest against the commutator, the engineer should be careful not to reverse the motion of his engine when starting, as he would spoil the brushes.

Iron nails, bolts and small tools should be kept away from the dynamo, as they may be attracted to the machine and damage it.

Oil cans for filling the oil cups of the dynamo should be of non-magnetic material (brass or zinc).

The dynamo must be kept scrupulously clean, like any other expensive machine. Any good engineer or dynamo tender will do that without being told.

Copper dust, which will be caused by the friction of the copper brushes against the commutator, should never show ; it should be cleaned off the armature and fields by means of a paint brush and a pair of bellows every day. Shafts and pulleys running near the dynamo must be prevented, by means of shields, from throwing oil on the dynamo, especially on the commutator.

A brush should never be lifted off the commutator while the dynamo is running.

Binding posts and other contacts should always be tight. A slight vibration of the dynamo, which will occur even when it is properly set, will loosen these connections in time. Every binding screw should be examined, and, if necessary, tightened every day.

The setting of the brushes is one of the most important duties of the dynamo tender. The brushes should rest against the commutator with a slight pressure. They should not be rigid, but the brush holder springs should allow a certain amount of spring ; this will prevent excessive sparking of the brushes, even if the commutator should be a little uneven.

The contact points for the brushes in the commutator are in most dynamos diametrically opposite each other. In order to find these points quickly it is advisable to cut a little strip of tin, the length of which is just one-half the circumference of the commutator, and use this strip as a gauge when setting the brushes. The brush holders should be carefully kept clean, and should be wiped off every time before the brushes are put in. The brushes must extend from each brush holder at equal lengths. The insulation between the brush holder pins and the quadrant must be in good condition ; oil and dirt must be kept out.

Fig. 5 shows the proper position of the brushes. The point where the brushes are resting on the commutator when the greatest current strength is obtained are called the maximum

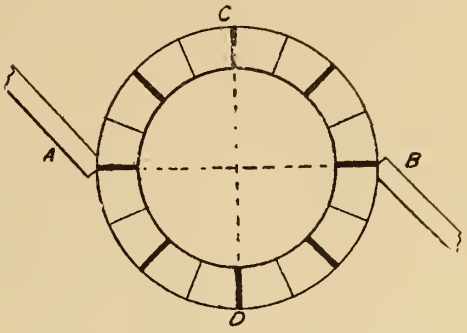


Fig. 5—Proper Position of Brushes.

points, *A*, *B*. When the brushes touch the points *C*, *D*, at right angles to *A*, *B*, called the neutral points, no current is obtained.

If the brush is nearly worn through to the middle of its thickness, it should be turned over and the other side used on the commutator. When both sides are worn off, as shown in the upper part of Fig. 6, the brushes should be trimmed. In larger stations, little brush cutting machines are used for this purpose; in smaller installations, two blocks of hard wood, lower part of Fig. 6, are used. The brush is put between the two blocks and the whole put in a vise. The end of the brush projecting beyond the wooden blocks is then removed by means of a file.

The brushes should also be in such a position on the commutator that the least sparking will be set up. In some dynamos it is necessary to move the brushes in proportion to the load in order to get little sparking. In other systems, the brushes need not be removed at all, no matter how many lights are turned on or off. In some dynamos, the moving of the quadrant, or, in other words, the moving of the contact points of the brushes on the commutator, is used for increasing or decreasing the strength of the current.

The commutator is the most sensitive part of the dynamo, and

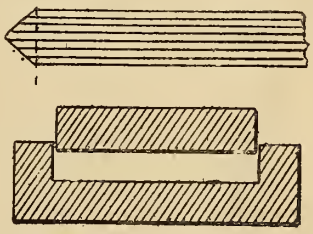


Fig. 6—Worn Brush and Blocks for Trimming.

should be especially cared for. It must always be kept smooth. If it should get rough from the electric spark, it is necessary to smooth it by pressing a block of wood covered with fine emery cloth against it, after having set the dynamo in motion with the brushes lifted off. If the commutator is so rough that a smooth surface cannot be obtained by the use of emery cloth, it should be filed. In order to do that, it is necessary to take out the brush holders, pins and brushes. After a straight surface has been obtained, the commutator should be smoothed with fine emery cloth.

The disadvantages of using a file on a commutator are the liability of pressing small chips of copper into the insulation between the copper segments, and the impossibility of getting the commutator true. The best way is to turn the commutator off by means of a little lathe, which can be attached to the dynamo, or by taking the armature out of the dynamo and having the commutator turned off in a lathe in a machine shop. This will not only make the commutator smooth but perfectly true. In filing or turning off the commutator while the armature is rotating in the dynamo, it is necessary to reduce the normal speed of the dynamo considerably, as too high a speed would spoil commutator and turning tools.

In new commutators for which fibre is used as insulation between the copper segments it is very often found that the thin sheets of fibre have absorbed moisture, and extend above the surface of the commutator. If a few days exposure in a dry warm room does not cause the fibre to shrink and go back to its

place, the surface of the commutator must be smoothed first with coarse and then with fine emery cloth.

In most systems it is advisable to put a little oil on the commutator just after starting the dynamo. Very little oil, however, must be used. Dip the point of one finger in one drop of oil, distribute it by rubbing it on the inner surface of the hand and apply what oil remains on the finger tip to the commutator, and take it off with another finger. This will do for at least three hours run.

If it should become necessary at any time to replace the commutator by a new one, it should be done in the following manner: Take the armature out of the dynamo and put the two ends of the shaft on two wooden horses. Mark the wires leading from the armature to the commutator by attaching little tags with numbers, to make sure of the proper place of each wire after taking off the commutator. Then disconnect these wires from the corresponding copper bars of the commutator, either by unscrewing the set screw, or in commutators which have solid connections, by unsoldering them by means of a hot soldering iron. Take the commutator off, clean the shaft and connections and put the new commutator carefully in its proper position and connect the wires in proper turn to the corresponding copper bars of the commutator by means of set screws, or soldering with hard solder. The greatest care must be observed not to short-circuit any parts of the commutator with drops of molten solder.

In most cases repairs to the armature are necessitated by injuries to the insulation of the wire from external mechanical sources or by excessive heat generated in the armature. The first is very often caused by little particles of material dropping in the spaces between armature and pole pieces—for instance, little balls of cotton waste being caught from the end of the dynamo and pressed between armature and pole pieces, thus scaling off the insulation of the wires in some places, or bursting the metal bands. Such injuries can have two different results, either short circuiting some of the coils or bringing different parts of the wire coils in contact with the iron core. These injuries hardly ever extend below the first layer of wire. In most cases it will be possible to carefully lift one wire at a time just high enough to wrap it with silk tape, and thus insulate it. After having wrapped and insulated all the injured parts, drive the wires back into their position by means of a small hard wood block and hammer, and give them two or three good coatings of shellac varnish. If the injuries are below the first layer of the armature, it will be necessary in most cases to have it sent to the factory to have it re-wound.

Excessive heat in the armature will very often char the insulation of one or more coils of wire entirely. These coils, of course, must be taken out and replaced with new wire. In most armatures of the so-called Gramme pattern this can be easily done. In armatures of the Siemens drum pattern it will necessitate a re-winding of the whole armature. The over-heating of one or more coils of an armature is very often caused by the short-circuiting of two or more segments of the commutator by means of copper dust which has been allowed to settle back of the commutator, or by excessive sparking of the brushes, forming little bridges of metal across to adjacent commutator segments.

The faults which mostly occur in field magnets consist in short-circuiting coils, or in getting parts of the field wire in contact with the iron core. The field wire should be unwound until the damaged part is reached, and after insulating it properly as described before, it should be wound back on the core. If it should be necessary to take a considerable amount of wire off the field in this way it will be advisable to put the damaged field magnet in a lathe and do the unwinding and re-winding by means of the lathe.

The iron frame of each dynamo must be well insulated from the wire coils of the field, the armature and also from any connection with the earth. If one of these wire coils should get in contact with the iron frame of the dynamo and the latter should be in connection with the earth by means of foundation bolts, etc., it would cause what is called a ground. The ground must be considered the worst enemy of electric light apparatus, and should never be allowed to exist. In testing for contact between field wire coils or armature coils and the iron, any wires leading to the circuits or other apparatus should be disconnected from the dynamo in order to make sure that the fault really lies in the dynamo itself. Another fault sometimes found in the field of the armature is called a short circuit.

A short circuit is a shunt of little resistance between two points of a conductor. Suppose the points *A* and *B*, in Fig. 7, are set in some way in connection. It is clear that the main part of the current will pass through *A*, *B*, and but very little of the current will pass through the coil. If this should occur in the armature, the coil thus short-circuited in itself will generate currents of great strength, which will destroy the insulation of this coil in a very

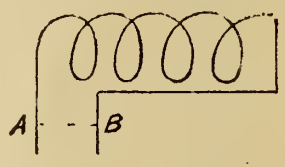


Fig. 7—A Short Circuit.

short time. Generally the dynamo tender will be warned by a smell of burnt cotton and shellac. If this fault should occur in a field magnet it would decrease its power, and thus cause the different magnets of the field to be of unequal strength. It may cause heating of the field in shunt and compound dynamos, while in series dynamos it will simply decrease the current strength generated by the dynamo. In order to test for a short circuit in an armature coil, or a field magnet, it is necessary to disconnect each field coil, or each armature coil, and measure by proper instruments the resistance of each coil. If any magnet coil shows a resistance below the others, it is short circuited. The use of the necessary testing apparatus can not be described here, as it would go beyond the limits of our space.

The short circuits in field coils, however, can very often be found without the use of finer testing instruments, simply by the use of the dector galvanometer and the cell. By connecting each field coil in series with galvanometer and cell, and marking the deflection of the galvanometer, the coil which will show the least deflection is the one which is short-circuited. A short-circuited field magnet will heat less than a sound magnet when the dynamo is generating current. A break of the fire can very easily be found by means of the galvanometer, as no deflection would be obtained at all through the broken coil. A break in a wire coil of the armature could only be found by disconnecting all wire coils from the commutator and from each other, and

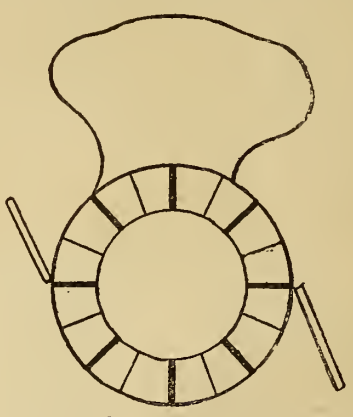


Fig 8.—Testing for a Break in an Armature Coil.

then testing each coil separately in the manner described. This, however, would involve considerable work and delay, and a quicker method may be employed : Set the dynamo in operation ; then take a short piece of wire and touch the commutator with the two ends of this wire at a distance of three or four segments apart, Fig. 8. If the machine should commence to generate current, an electric arc will be formed on the commutator between the two ends of this wire, and indicate there is a break in the armature wire. The machine must be shut down quickly, as otherwise it would cause damage in the commutator and armature. The coil of the armature in which the fault lies can be easily recognized by the burns on the corresponding segments of the commutator. Faults of this kind are very often found in poor contacts between two coils, or between a coil and the corresponding copper bar of the commutator. Poor contacts will cause more trouble than actual breakage of the wire. Such faults will often destroy certain commutator segments, caused by increased sparking of the brushes when passing these points. Hence, if only one or two commutator segments should show

rapid destruction from the electric spark, all the connections between these segments to the corresponding armature coils should be well examined, and, if necessary, cleaned and well tightened, or made solid with solder. The poor contact between parts of the field wire coils can be very often discovered by holding a piece of iron, for instance a machine wrench, near the pole piece without touching it. If the contacts are good the wrench will be attracted with a uniform force ; if poor, these forces will vary and cause a single vibratory motion of the wrench in the hand.

BOILER EXPLOSION AT ST. JOHN, N. B.

On November 30th two steam boilers in a saw mill at South Bay, near Saint John, N. B., exploded with great violence, causing the death of eight persons and injuring a large number. Considerable damage was done to the property, and about three days after the explosion fire broke out in the portion damaged and the mill was completely destroyed.

There were six steam boilers in one battery in the boiler house. The boilers were of the style commonly used in saw mills in the Maritime Provinces, and sometimes called "Log Boilers." They were cylindrical, egg ended boilers about 33 inches diameter and 35 feet long. There was an equalizing pipe crossing the boilers in such manner that the water was free to flow from one boiler to another, and as all were connected to same steam pipe and were subjected to the same pressure, under ordinary circumstances the water leve would be uniform in all the boilers, and if low in one would be low in all. Such at least was the design of the arrangement, and there is no reason to suppose that in actual work the equalizing pipe did not answer its purpose.



Scene of Boiler Explosion at St. John, N. B.

A coroner's inquest was held and a large number of witnesses examined. The explosion occurred about nine o'clock in the morning, at a time when the engineer was at his home for breakfast. The assistant engineer stated that the feed pumps was working at full speed, and had been so for some time ; that the engines were running as usual and the safety valves blowing off. The steam gauge showed a pressure of 60 lbs. per sq. inch, and the water gauges showed that the water was high in the boilers. He went to the pump to shut off the water and was in the act of doing so when the explosion occurred.

Other witnesses who had been working in the mill spoke of water having been thrown around them and the mill at the time of the explosion. Parts of two of the boilers were thrown out into the water about 1,000 feet from the boiler room, and the explosion was a violent one. From the evidence, there did not appear to have been two distinct explosions heard or seen by any one. The boilers which exploded were not next to each other, but were said to be Nos. 2 and 5 of the battery. It has frequently happened that where a number of boilers are worked in one battery, the explosion of one has led to the others going off as well. Sometimes witnesses have described these explosions as following one after the other, like shots from a revolver.

No doubt, in this case, one part of one boiler commenced to give way, and led to such disturbances within the other boilers as caused the other to explode. Why did not all the others go up to ? The evidence shows that the boilers were not all of the same age. They had been in their present position for about six years, but some of them had done service in other mills before being fitted up at South Bay. They were not all of equal quality, and there seems no reasonable doubt that the weakest exploded. A critical examination and test of the ruptured plates would doubtless show the reason why they ruptured and the others did not.

The jury brought in a peculiar verdict. They found that the boilers were short of water, and that from overheating they exploded. They add a recommendation that the Dominion Government be urged to make boiler inspection compulsory, and that persons running steam boilers in mills be required to hold a certificate of competency. They did not blame any one, yet the verdict intimates that the boilers were not what they should have been and that the men in charge of them could not have passed the necessary examination for certificate of competency.

The evidence of those most likely to know showed that there was plenty of water in the boilers, and some of the dead and injured were severely scalded, yet the water was low ! It is the common idea of many that low water is the necessary cause of a boiler explosion.

It seems to be too much to expect from an ordinary jury that they should be able to understand the various technica points involved in a boiler explosion investigation. In Britain, when any accident of the nature of an explosion occurs to a steam boiler, an enquiry into the matter is made by a competent engineer acting for the Board of Trade. If the accident has been a serious one or produced serious results, after the preliminary investigation the owner of the boiler is liable to be tried before a court composed of engineers and a lawyer appointed to try the case for the Government. The object of this trial is to discover the cause of the explosion and to fix the blame on the proper person. Reports are published of these cases and much valuable information is given to the public and warnings issued to boiler owners and attendants. The punishments inflicted are fines or imprisonments. This method is a great improvement on the plan of leaving it to a coroner's jury to say whether or not the explosion was caused by any culpable negligence.

The statement is made that a movement is on foot for compelling periodical inspection of boilers in Canadian saw mills and licensed engineers for saw mills. If such a law were to prevail in this country there would be a great demand for competedt engineers, for there are thousands of them now running mill engines who could not obtain the proper certificate of ability. —*Woodworker.*

Before the Street Railway Committee of the Toronto City Council, recently, Mr. Cargill, of the Thomson-Houston Electric Company gave statistics of the relative cost of electric and horse power, saying that in some cases the reduction had been from seventeen to nine cents per mile, or eight cents per mile in favor of electricity in one case, and from seventeen to thirteen in another. In Toronto the difficulties of electricity would probably be increased by the severity of the winters, the high price of coal and other considerations.

SHRINKING CRANKS ON SHAFTS.

A WRITER in a foreign journal gives the following method of shrinking a crank on a shaft: "When the crank has sufficiently expanded remove it smartly from the fire, and clear the hole from cinders, etc., by means of a wire brush (a piece of waste is not a good thing to use, as portions adhere to the metal and carbonize, remaining in the hole). Have tackle ready to immediately sling the crank upon its bearing, driving it on with a lead or copper hammer, or a sledge driving upon wood blocks, so as not to damage crank face. As soon as sufficiently driven home, drive a key in the keyway, a slack fit top and bottom, and a sliding fit sideways, thereby adjusting the crank accurately upon its seat. Try a square upon the crank neck and the boss to see that the crank is put on square with its shaft. Allow to slowly cool, and fit the keys."

THE SMOKE PROBLEM IN ENGLAND.

ACCORDING to *Iron* of London, a Mr. Elliott, of that city, proposes to solve the smoke problem by condensing the smoke in water and recovering the by-products. To this end he has a tank of water in which are revolving stirrers driven by a small engine or by spare power. By means of a fan he draws the smoke from the chimney and forces it into the water at a point near the bottom of the tank. The smoke and products of combustion are then churned up together in the tank, the solid particles of the smoke and the sulphurous vapors and noxious fumes being arrested in the water. In time the heat of combustion warms up the water, and the steam is allowed to escape through a chimney into the air. When the water has become fully charged with the condensed smoke and other matters, it is drawn off and the tank is refilled with water. The charged liquor is to be afterwards treated, and the by-products due to the combustion of the coal are to be recovered. By this means it is claimed that not only will the smoke nuisance be abated but that a profit will be derived from the operation.

A WIRE BOUND FLY-WHEEL.

A NOVEL fly-wheel of large dimensions, which differs materially in construction from those ordinarily in use, has been designed by Messrs. Mannesmann to guard against the terrible danger of bursting, to which accident cast iron fly-wheels are only too subject when worked at a high speed. This wheel, which is in operation at the Mannesmann Tube Company's works, in connection with their process for making seamless tubes, consists of a cast-iron hub, to which are securely bolted two discs of steel plates of about 20 feet in diameter. Round the periphery of the wheel thus formed about 70 tons of No. 5 gauge wire are wound, under a tension of about 50 pounds, thus binding the whole securely together. There can be no comparison between the resistance of a wheel so constructed to the centrifugal force, and that offered to this force by a cast-iron one. This fly-wheel, of 20 feet diameter and weighing 70 tons, revolves 240 times per minute, therefore the periphery of the wheel has a speed of 2.85 miles per minute, or nearly three times the speed of the "Flying Dutchman." It works on the main shaft from which the tube mill is driven by means of helical toothed wheels.—*Specialties.*

TRADE PAPERS.

As indicating the important position which trade and technical papers occupy at the present time, it may be mentioned that the managers of the advertising departments of the prominent daily papers are at present instructing their canvassers to give no attention whatever to soliciting lines of business in which the general public is not interested, and in which the services of the trade paper would be more likely to bring results than a daily paper. The rule is so closely followed by a number of the leading papers of the country that it may be accepted as the general policy of the newspapers of the day. Trade papers are constantly occupying a higher place in the estimation of the business public, and more particularly in the estimation of the manufacturers and wholesalers who use them, and upon whose patronage they depend for support. While trade papers a short time since consisted of little more than mere advertising pages, with random clippings from various sources, they are at present the result of the labor of large corps of able and experienced writers; and, taken collectively, they exhibit more originality and more enterprise than, perhaps, any other class of periodicals at present published, not excepting the leading literary magazines.—*The Office.*

SPARKS.

The town of Palmerston, Ont., is to have twelve electric lights.

Regina, N. W. T., is now in the enjoyment of electric street lighting.

The electric light is about to be introduced in the village of Arthur, Ont.

Terrebonne, Que., was lighted by electricity for the first time a few days ago.

An effort is being made to form a local electric light company at Athens, Ont.

The Methodist Church at Essex Centre, Ont., is now lighted by electricity.

A system of incandescent electric lighting is about to go into operation at Kamloops, B. C.

The Bell Telephone Co. will supply the town of Gananoque with an electric fire alarm system.

The Ball Company's engine house at London, Ont., is being enlarged to accommodate a new 125 h. p. engine.

A joint stock company is in process of formation at Exeter, Ont., to purchase the necessary plant to light the town.

During the year just closed the Bell Telephone Company erected in Canada no less than 1,380 miles of trunk line wire.

The Bell Telephone Co. propose to establish a night service at Chatham, and supply the town with an electric fire alarm system.

The Vancouver, B. C., Electric Light Co. has suffered much annoyance by the breaking of arc light globes by mischievous boys.

The Canadian electric companies are experiencing considerable difficulty in getting poles, and owing to the scarcity the price has risen.

Messrs. Corley & Collins, of Mount Forest, Ont., have purchased a 40 light dynamo and will supply arc and incandescent lighting to the citizens.

It is said that the prospect for the construction of an electric street railway at Kingston, Ont., is almost certain to be carried out the present year.

Dr. Groves has introduced the electric light in the town of Fergus, Ont. It is the purpose to supply current to Elora and one or two other neighboring villages.

A number of converters sent into Manitoba by an American company, of St. Paul, were recently seized by the Canadian Customs authorities on account of undervaluation.

The telephone wires were recently stripped from the poles in Windsor, Ont., by a couple of enterprising theives, who were arrested while trying to dispose of them in a Detroit junk shop.

The Hamilton Electric Light Company's plant and business has been leased by the Electric Light & Power Company. Mr. W. J. Clarke, late of Trenton, is the manager of the new company.

The employees of the Brooks Mfg. Co., of Peterborough, recently presented Mr. Taylor, superintendent, and Mr. Castle, foreman, with kindly worded addresses and other tangible tokens of esteem.

The Ontario Telephone Co., of Peterborough, have recently supplied an instrument for the benefit of persons with defective hearing. The receiver has an ear trumpet attachment which has proved an entire success.

The Ontario Government has incorporated the Toronto Telephone Company with a capital stock of $250,000. The promoters are: Alex. Nelson, Abner Nelson, Toronto; W. Travers, Paris; John Ritchie, jr., and Louis Gibson Harris.

The Standard Electrical Company, of Ottawa, is the name of a new organization which is applying to the Ontario Legislature for incorporation with the object of producing, selling and supplying electricity for purposes of light, heat and power.

New buildings are being erected at New Westminster, B.C., for the electric lighting plant, which will be owned and operated by the city. The building has been planned with a view to increasing the plant and power in future as required, and is situated at a convenient distance to blow in for fuel the refuse from one of the large saw mills.

The Bell Telephone Company is said to have issued a writ against the Brantford Electric Light Company, claiming $5,000 damages for erecting its poles and wires in such a way as to endanger the property of the telephone company and its subscribers, and asks for an injunction to compel the removal of the electric light wires to a proper position.

The specifications drawn up by the Toronto City Council as the basis upon which tenders will be received for the privilege of operating the street railway system, provides that an electric, cable or other new system of motor, or a combined system recommended by the City Engineer, and approved of by the Council as suitable, is to be introduced at once and used, at least on the main lines, within two years.

Messrs. Henderson Bros., of Montreal, have applied to the Quebec Legislature to incorporate the Ries Electric Traction & Brake Company, of Canada, with a capital stock of $1,000,000, with the object of largely increasing the traction of railway locomotives, and for the operation of locomotive and train brakes, head lights, and train lighting. Very successful tests of the Ries invention have been made in the United States.

SPARKS.

The construction of the New Westminster, B. C., electric tramway will commence immediately.

The municipality of St. Cunegonde, Que., will exchange its incandescent for arc lamps for street lighting.

The Malleable Iron Works at Walkerville, Ont., are constructing an electric light plant for their own use.

The Bell Telephone Co. will shortly commence the construction of a line from St. Thomas to Ridgetown, Ont.

The Cobourg Car Works Company will probably engage in the manufacture of cars for use on electric railways.

Messrs. Cliff & Foster, of Goderich, Ont., have installed in their furniture factory a 40 light incandescent plant.

The town of Lucknow has contracted with the Ball Co. for eight arc lights of 1,000 c. p for 280 nights each year, at a cost of 15 cents per light.

The streets of Hespeler, Ont., will be lighted from dusk till midnight, 280 nights in the year, by ten arc lamps of 1,500 c. p. at a cost of 17 cents each per night.

Mr. Kenneth Dunstan, Manager of the Bell Telephone Co., Hamilton, recently delivered an interesting address to the young mechanics of Hamilton on "Electricity and its Uses."

The Hamilton Gas Company asks permission of the Council to lay electric wires underground, from which the inference is drawn that competition in electric lighting has been decided upon.

A difficulty having arisen between the Town Council of Oshawa and Messrs. Edmonson, owners of the electric light plant by which the town is lighted, new tenders for lighting have been invited.

The firm of Patterson & Corbin, of St. Catharines, has received a $15,000 order for ten electric cars for the Ottawa Street Railway Company. They ask the city for $10 000 to assist them in erecting a factory for the manufacture of street cars.

W. Brown, a telegraph line repairer, of Hamilton, while walking on the Northern and Northwestern track recently, discovered a bear lying between the tracks. Bruin indicated his desire to make a meal of him, but in this he was disappointed by the good use which the lineman made of his legs.

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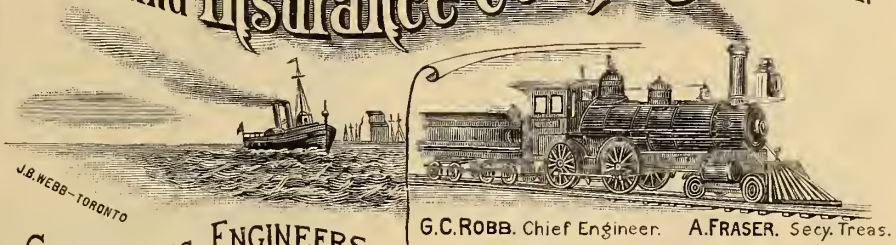
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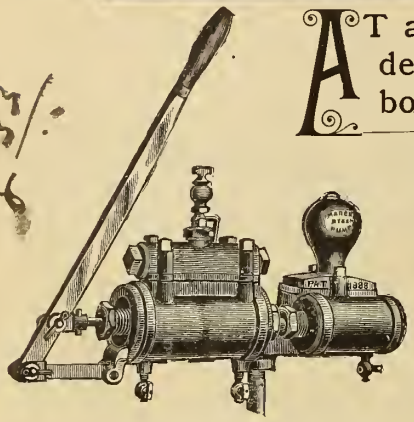
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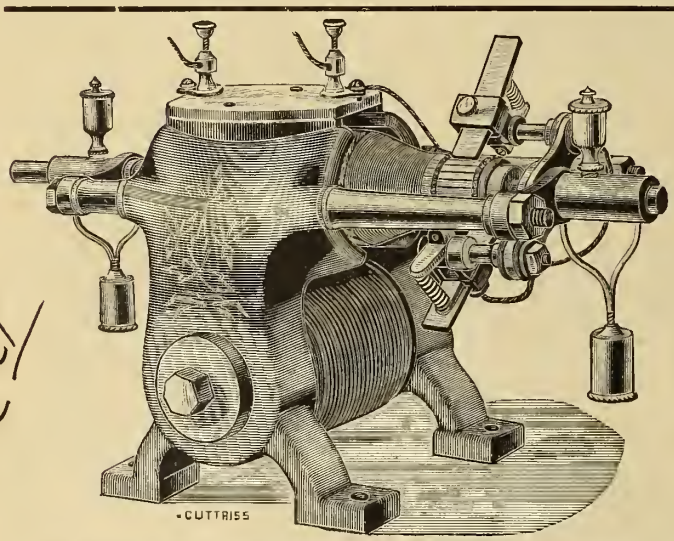
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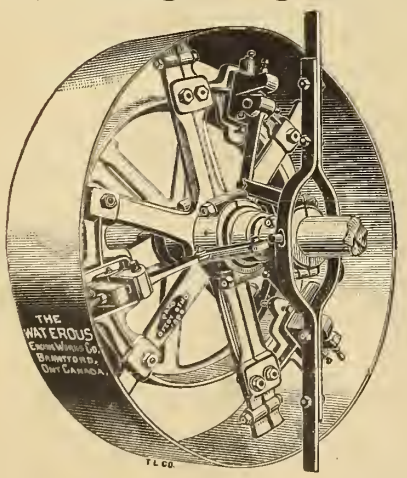
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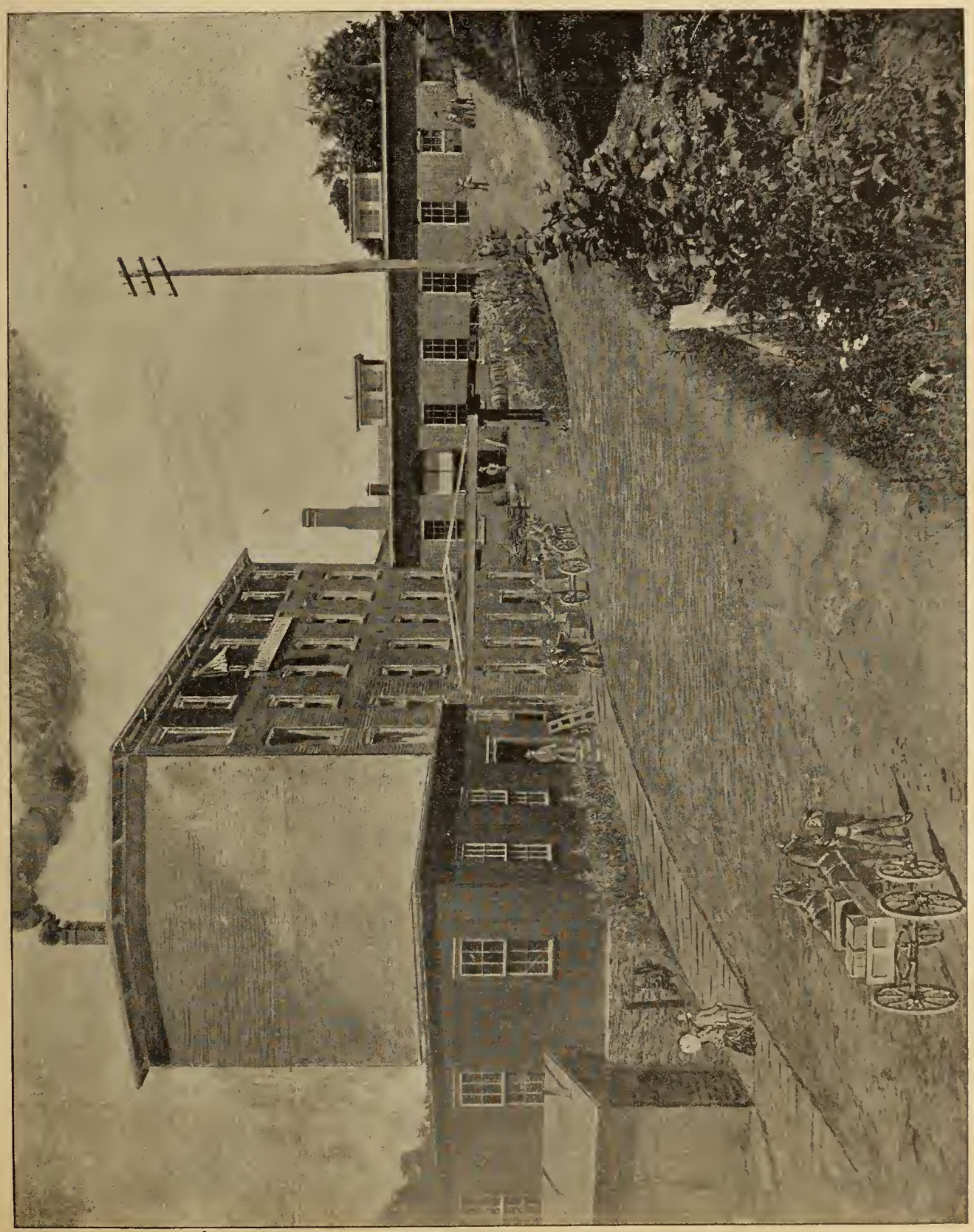
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CANADIAN WORKS OF THE EDISON GENERAL ELECTRIC CO., SHERBROOKE, QUE.

EDISON GENERAL ELECTRIC CO.'S WORKS AT SHERBROOKE, QUE.

THE Canadian works at Sherbrooke, though small in comparison with the Edison company's American establishments, present more points of interest than any one of these, for here are combined the industries embraced by the New York and Schenactady works. Indeed, we find here the manufacture of all machinery and appliances necessary for the equipment of all kinds of plants for the supply of light and power, except lamps. In the dynamo department there are always in course of construction machines of all sizes, from the small "250-watt," which supplies current for five sixteen-candle power lamps, to the "No. Thirty-two," designed to run 1,150 lamps of the same lighting power. The motor department turns out machines for all kinds of work and for a large range of capacity, from ¼ to 75 horse power. These are both for stationary and street car work.

The foundry is occupied with the production of castings of brass in every size and shape, ready to be passed on to the machine shop, where by means of lathes, drills, punch-presses and other suitable machinery they are fitted up for the purpose they have eventually to serve. In the carpenters' and pattern makers' shop patterns are made of parts of machines which the moulders will afterwards turn out in brass and iron. The cable department supplies all varieties of stranded conductors for conveying currents for different classes of work, amongst which the chief are telegraph, telephone, lighting and power. Here, amongst others, are made large lead covered telephone cables, some of which contain upwards of two hundred separately insulated wires, and composite conductors designed for every kind of overhead, underground and subacqueous purposes. On these the tube department are now working—the method of manufacture being as follows: Copper rods of thickness varying from ¼ inch to 4-5 inch have wound round them a spiral of rope saturated with a liquid insulation, after which three rods are bound together with a similar larger spiral. The bundle is then slipped into a length of pipe, the ends of the rods being allowed to protrude at each extremity. A viscid bituminous compound is now forced in under pressure, so as to completely fill all the interstices between the copper, rope and pipe, rendering the whole tube impervious to moisture and gases. The ends of the pipe are then closed with rubber plugs, through which the rods are allowed to appear, and the conductors are tested, after which they are ready for shipment. Contigous rods are connected when laid underground, by flexible copper cable, which allows for expansion and contraction of the conductors caused by heat or cold. Two tubes may be joined together, either in a straight line or at any angle required. The connecting joints are covered by cast iron coupling boxes fastened to the ends of the tubes, which are filled with insulating compound. Another product of the Canadian works consists of insulated wire of all descriptions. From the wire department are produced magnet and armature wires, weather-proof line wire, rubber-covered wires for sundry purposes, office wires, annunciator wires, gas fixture wires, tinsel cords, resistance wires, non inflammable house wires, and silk and cotton braided flexible cords for hanging light, and so forth. All sorts of metals are here worked on, from the gold cord in the tinsel and the German silver in the resistance wire to the usual copper conductor and the galvanized iron of telephone lines. The range of size runs from stout rods of copper, half an inch in diameter, to the filament gauging only fifteen ten-thousandths of an inch—half the thickness of the human hair, one pound being 32 miles in length. Insulation is effected by means of silk, cotton, rubber, worsted and other materials of a non-conducting nature. The growth of the whole works has been steady and rapid. Starting in the spring of 1889, only a small force was employed, but this has increased, until to-day there are over 220 hands on the rolls, and this number will soon be considerably added to. The necessities of the industry compel a constant addition to the list of departments, the latest amongst which is the result of a contract with the Thomson International Electric Welding Company, whereby the Edison works have agreed to build the necessary outfits for all welding plants, started in Canada under the Thomson Company's patents. Besides the articles already enumerated, these works produce ready for the market, all kinds of general electric appliances and supplies, such as meters, switches, pockets and receptacles for lamps, cut-outs, regulators, Ampere-meters, volt-meters, resistance boxes, etc.

It is gratifying to learn that the company's Canadian business has grown to an extent that has rendered necessary the erection at Peterborough, Ont., of new workshops of greatly increased capacity, in which operations will be continued on an extended scale the coming spring.

WHAT SHALL AN ENGINEER STUDY?

BY "AUTOMATIC CUT-OFF."

THIS is a very important question, and one that cannot be settled off-hand. The term engineer is so widely used that every person who has anything to do with boilers, engines or steam, whether he be the veriest stocker who just knows a steam gauge from a glass water gauge, or a first-class man, even a graduate from a Technical College or a man capable of taking full charge of one of our ocean greyhounds—all come under the name of engineer.

No matter what position a man holds in the engineering world, he should have knowledge enough to manage safely the steam plant under his care, and if the employers insisted upon this being proved to their satisfaction, they would save themselves some anxiety and considerable money. I heard an employer say: "I don't want any book-learned engineer around my place; I pay my men to work." Well, he got what he wanted, and in a few days there was a shut-down in the middle of the afternoon—146 men standing still. Upon inquiry as to what was wrong, the engineer (?) said he had no water, and could not get the pump to work. After spending two hours on it, they sent to a neighboring machine shop for a man. In ten minutes the machinist found a piece of scale under check valve, and had there been water enough in the boiler, the machinery could have started at once, but as the case was the boiler had to be cooled off and then filled up by hand. The loss in this case is considerable—146 men three hours, equals 438 hours, or 43 days for one man.

Now if this engineer (?) had "book-learned" enough of the principles upon which a boiler feed pump works, he would not have been stuck so easily, and undoubtedly in that case would have saved his employer the cost of 43 days labor.

From the fact that at the present day steam engineering is running to faster speeds and higher pressures, as well as better compounded engines, it becomes necessary for the engineer himself to acquire more knowledge, in order to work with the same degree of safety for himself, his fellow employees, and his neighbors. The opportunities for gaining knowledge have advanced as rapidly as the improvements in the machinery, so that there is no excuse to be made for the engineer who does not "keep up with the procession." It is not to be expected that all men can attain the same degree of knowledge, even with the same advantages, neither is it necessary for men running engines to have a technical education, but all men in charge of steam plants should study natural philosophy and hydrostatics. They should learn enough about chemistry to help them about combustion, that they may properly use their employer's coal. They should understand arithmetic, at least as far as square cube root. Any engineer who is master of common arithmetic that far, can always work the problems he may meet with in ordinary, everyday practice.

One trouble the student meets right on the threshold is, that the mechanical books he studies from do not agree on many points. In some instances the rules given by two different writers result in different answers. This is confusing to the student, and should be corrected by some means. We should have standard rules, so that results would be alike in the whole mechanical world. If we had license and inspection laws it would tend greatly to remedy this trouble, as it would become a necessity to have a fixed standard by which to conduct the business.

There are many instances occurring wherein the engineer who studies has the advantage. One I call to mind where an engine had been doing very well for nearly a year from the time it was started. All at once the crank pin brasses began to give trouble. The connecting rod was of the English stubb end pattern, and the brasses were held in place by two bolts with jamb nuts on them bolting them to the stub end of rod. The engineer soon found that these bolts were stretching, and wrote the builders of the engine to that effect. They were positive the bolts were all right—had been making many just like them and all were satisfactory but this one—the engineer must be mistaken, etc., etc., in fact they repudiated the whole thing. In the meantime one of the bolts broke. It was renewed by the builders, but at once began to stretch. Our engineer by this time had got tired trying to get these brasses to run right. As he was a member of one of the engineering associations and had been gaining knowledge, he concluded to figure out the strength of the bolts, and the strain put on them when the steam was admitted to the cylinder. These figures proved plainly that the bolts were too small in sectional area to stand the strain put upon them. These figures were sent to the builder of the engine, and the result is that the engine is supplied with stronger bolts and the trouble for ever cured. Now if that engineer could not have done this, there would have been many shut downs, and every body and every thing but the right one would have been blamed.

I may say here that when this engineer joined the society he could not figure up the strength of one of those bolts any more than he could fly. I could go on and cite instances enough to fill this paper, where the engineer has been of signal service to his employer by studying and practising a little "book larnin." I say, engineers, study to be equal to all your duties, and employers, get a man who can prove he knows how to manage a steam plant.

MR. ARTHUR AMES.

THE subject of the accompanying portrait is President of No. 4 Branch of the Canadian Association of Stationary Engineers at Brantford, Ont. He was born in the city of Toronto in 1857. A few years later he removed with his parents to Stratford, where he attended school until fourteen years of age. The next three years of his life were spent in a stationary and drug store.

Having a greater liking for mechanics' than for commercial pursuits, and being particularly attracted towards steam engineering, he set to work to study along the lines of desired knowledge. The information thus gained served but to intensify the natural liking.

After having gained some experience, Mr. Ames in 1877 entered the C. T. R. shops at Stratford. After remaining there for a year and a half he was transferred to the company's car shops at Brantford and given charge of engine and boilers. In this capacity he spent two years, at the end of which period he severed his connection with the company to accept a position with Wm. Paterson, Esq., M. P., wholesale manufacturer of biscuits and confectionery, in whose employ he has now been for ten years.

BRANTFORD BRANCH NO. 4, C. A. S. E.

Brantford Branch No. 4 of the Canadian Association of Stationary Engineers was organized in June, 1888, with eight charter members. Mr. A. M. Wickens, then President of Toronto Branch No. 1, was largely instrumental in bringing about the result.

This branch has at present 15 members in good standing, embracing it is believed all the reliable engineers of the city. Its future growth is limited by the comparatively small number of manufacturing industries. Any lack in numbers is fully compensated for by the enthusiastic interest in the success of the institution manifested by the present membership. The meetings are well attended and profitably conducted, and the finances in a healthy condition. The society has a nicely furnished hall, on the walls of which are hung handsome photographs of the productions of leading steam engine and pump manufacturers of Canada and the United States.

The Society holds its regular meetings on the second and fourth Friday in each month. The names of the officers for the present term are: A. Ames, President; Thos. Pilgrim, Vice-President; Joseph Ogle, Secretary; Lewis A. Fordham, Treasurer.



MR. ARTHUR AMES.

A WORD TO ENGINEERS.

EDITOR CANADIAN ELECTRICAL NEWS.

SIR,—I am in receipt of the first copy of the ELECTRICAL NEWS, and, in my humble opinion, it will supply a long-felt want among electrical and steam engineers in Canada.

At the present time there is, and will be, a still greater demand for engineers who are competent to successfully operate dynamo machinery in connection with their steam plants. This being the case, every intelligent engineer should make it his business, not only to get the necessary information to enable him to run a dynamo, but he should also become a subscriber for the above paper, and others treating on the same subjects, so that he may be enabled to keep up to the times in all matters appertaining to his calling, so that when he has the opportunity of securing a better position, he may be ready for it, and not be left behind by the other fellow who had sense enough to see the necessity of fitting himself with the necessary knowledge and "know how to get there."

There will be many openings for engineers during the next few years to take charge of electric light and power plants, and it will be their own fault if they are not prepared for the occasion.

Our Canadian Association of Stationary Engineers offers advantages to every engineer in Toronto in the educational line, which is its chief feature. We meet every second and fourth Friday, in Room D, Shaftesbury Hall. After the general routine of business, there is always some subject brought up for discussion, each one giving his views thereon, and I can assure you that it is productive of much good.

I know men who, when they joined the Association couldn't figure out the area of a 12" circle, who can now get up to the black-board and figure out almost anything.

The trouble is that many of the steam users and engineers do not sufficiently appreciate the objects of the Association.

I must apologize, Mr. Editor, for taking up so much of your valuable space, but this is my first offence. I wish the NEWS every success, and trust that its circulation may surpass your most sanguine expectations.

Yours truly,

ALBERT E. EDKINS,
Pres. Toronto, No. 1.

22 Agnes Street.

HEAT THE FEED WATER.

IT cannot be too often stated that the steam engine is a heat engine. Many young engineers, and even some who are no longer young, seem to think that somehow or other it is the *pressure* that is the main thing to be considered, forgetting that the heat is the source of the pressure. The engine that converts the most heat into power is the one that is most economical to use. Engine owners will admit this, and yet will use an engine that throws away exhaust steam into the air—proving a nuisance to all the neighbors—and will at the same time pump cold water into the boiler, or put it in by means of pressure from the city mains, because that saves the expense of a pump.

In the winter time the temperature of water in the city mains in Toronto is as low as 37° Fah., and may at times be even below that. In an ordinary boiler with steam at 80 lbs. pressure on the gauge, the water in the boiler will be about 324° Fah., and the exhaust steam thrown out by a common high pressure engine may be as low as 213°, or as high as 220° or more. Suppose the steam to enter the engine cylinder at 324°, and the exhaust to leave it at 213°, there is a fall in temperature of 111°. If the feed to the boiler be from the city mains at 37°, the difference between that and the temperature of the exhaust is 176°—more than 50% of a greater difference than between entering and leaving the cylinder. That is, more heat is thrown away than is expended in the cylinder. If even a portion of the heat of the exhaust were used to heat the feed water there would be a gain, and the question to be considered is, how much is that gain?

With steam at 80 lbs. pressure in the boiler, and the water in the boiler at 324°, the feed water of 37° has to be raised 287°, but to get it into steam over 1,176 heat units have to be added. The total temperature from zero is 1,213°.23, and 37° the temperature of the feed water subtracted, leaves 1176°.23 to be added. If by the exhaust steam the feed water be raised to 190°, then 1213°.23 less 190° = 1023°.23 to be added, or a difference of 153°. A saving of 153° on 1,176°.23 amounts to 13%, or 260 lbs. on each ton of coal used.

In a mill using about 160 h. p. the exhaust steam leaves the engine at about 3 lbs. pressure, the feed water is heated to a temperature of 208°, the mill itself is heated in the winter time, and after that there is still enough left to heat the water used in a large dye house to 160° temperature. Wherever there is exhaust steam from an engine some use should be found for it, as the owner might just as well dump some of the coals into the lake every day as blow the steam off into the air.

The city electric committee of Vancouver B. C., have in preparation their report to the Board of Aldermen recommending the addition of new engines of 200 horse power or more to the city's electric light plant. The committee will also advise the purchase by the corporation of the plant and business of the gas works, and Electric Illuminating Co., and Tramway Co., and that when this shall have been accomplished lal the wires be placed underground.

ELECTRICAL INSTRUMENTS.*

CURRENT INDICATOR OR AMPERE METER.—This apparatus is to indicate the current strength at all times. It should be put up in each case where a constant current strength is required as in arc light circuits or in the series multiple system of incandescent lighting. The instrument must be connected in series with the arc lamps or with the groups of incandescent lamps in the series multiple system. It is also used in the multiple arc or multiple series system and is always put in one outgoing wire of the dynamo, Fig. 1.

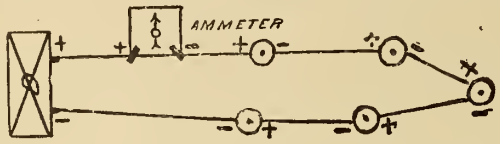


FIG. 1.

PRESSURE OR POTENTIAL INDICATOR, OR VOLTMETER.—This instrument is absolutely necessary on dynamos which must be kept at a constant e. m. f., as in the multiple arc or multiple series system of incandescent lighting. The instrument is connected in parallel with the lamps, as shown in Fig. 2.

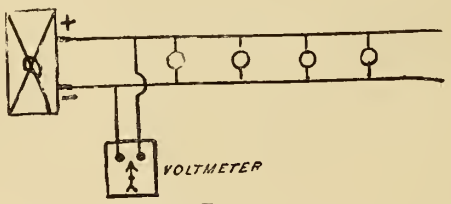


FIG. 2.

CURRENT REGULATOR.—This instrument, also called rheostat or resistance box, consists of a box which contains wire or some other resistance and which can be switched in or out of the electric circuit by means of a crank. If this is to be done by hand, the instrument is called a hand regulator; if done automatically it is called an automatic regulator.

The regulator for series dynamos is connected anywhere in the circuit, the whole current generated by the dynamo passing through it. By putting more or less resistance in the circuit, the current flowing through the other parts of the circuit can be strengthened or weakened. In shunt dynamos the regulator is put in the shunt winding of the field. Putting in or taking out the resistance decreases or increases the strength of the field magnets and thus controls the current generated in the armature. In some arc light dynamos the regulation of the current is effected by putting more or less resistance in shunt with the field circuit, and in others by automatic devices for shifting the brushes. The movement of the latter towards the neutral point will decrease the current, while moving it toward the maximum point will increase the current strength.

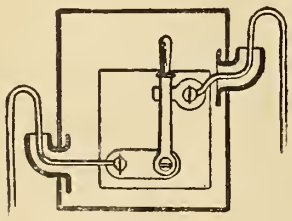


FIG. 3.

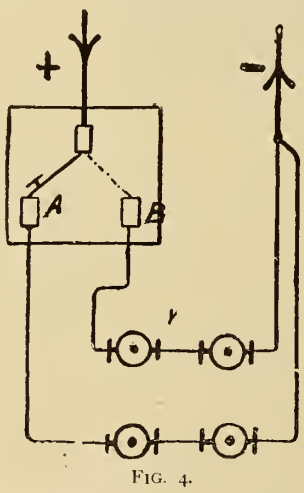


FIG. 4.

SWITCHES.—A switch is an instrument to break or make circuit, or, in other words, to cut off the current in certain places for a number of lamps or cut them in again. The switches should be constructed so that they will open and close very quickly and not show very much sparking. [See Fig. 3.] This is accomplished by having the switch so arranged that the human hand will start it, while a powerful spring throws the switch open or closes it immediately. The contact should be sufficient to prevent any heating at these points.

Two-way switches are used in various ways; for instance, for two different sets of lamps. If one set of lamps is not required, the handle, as shown in Fig. 4, is moved from *A* to *B* and the lamps marked *X* will go out, while those marked *Y* will be started.

SAFETY DEVICES.—Strips of an alloy which fuses at a low temperature are used as safety devices, or plugs, in incandescent wiring. The cross-section of the plug must be of such size that it will melt before the wire it protects gets dangerously warm. Hence the diameter of the safety plug depends upon the cross-section of the wire to be protected and not upon the number of the lamps. The safety plug is not supposed to protect incandescent lamps from an excess of current, but to protect the building from fire by preventing any part of the electric light conductors from getting too hot. The marking of safety plugs with the number of lamps they can carry has misled many an employe of an electric light company to think that the plugs are put in for the protection of a certain number of lamps. The marking of the plugs simply expresses their carrying capacity in 16 candle power lamps instead of in amperes. See Fig. 5, in which safety plugs are marked *S*.

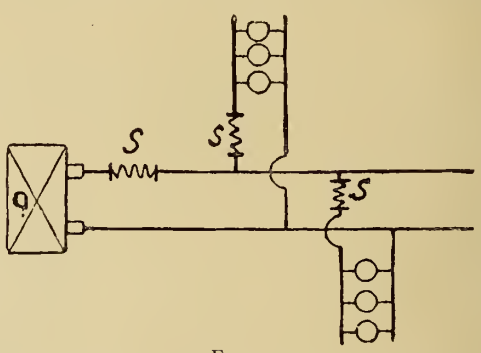


FIG. 5.

The blowing out of safety plugs is very often caused, not by an excess of current, but by poor contact between safety plug add safety plug holder. A poor contact, of course, will generate heat, which will gradually fuse the metal on one end.

LIGHTNING ARRESTERS.—Where electric light lines are put up outside of buildings, they are liable to be struck by lightning. To meet such a contingency, the dynamo and station apparatus are protected by a lightning arrester (fig. 6): *D* represents the dynamo; *A* and *B* are brass plates, through which the two outgoing wires pass, and *C* is a brass plate connecting to moist earth. The space between the toothed sides of *A* and *B* and the centre plate *C* is adjusted to the thickness of a piece of cardboard. If lightning should come in on one of the wires, it would leap over this narrow space and run into the ground without doing any serious mischief. Such an arrester will keep the lines discharged, and very often during a thunder storm the atmospheric electricity will continuously leap across these plates in the form of blue sparks. These discharges may sometimes cause the centre plate to fuse to one or even both toothed plates. In the latter case, the current of the dynamo may follow the arcs which are simultaneously set up between *A*, *C* and *B*, *C*. If the centre plate should be fused to both toothed plates the dynamo would be shhrt-circuited through *A*, *C*, *B*, and the belt would be thrown off or the armature, and possibly some of the instruments in the circuit, might be burned.

In order to prevent such an accident, numerous devices have been designed to operate in connection with the lightning arrester. They may be classified as follows:

First, Safety fuses inserted between the dynamo and the strips *A* and *B*. They will fuse when the dynamo is short-circuited, break the current and thus save the armature.

Secondly, Electro-magnets which are energized when the dynamo is short-circuited and open the circuit.

Thirdly, Devices which will extinguish any electric arc that might be formed between *C* and *A* or *C* and *B*. Such devices are based on the principle that a magnet will attract the electric arc and pull it away from the plates *A* and *C* or *B* and *C*.

Whatever devices are used, one important point should not be overlooked. This is the absolute necessity of a good earth contact. The wire leading from *C* to earth should be at least a

* From "Dynamo Tenders' Hand-Book."

number 4 Brown & Sharpe copper wire. This wire should be solidly connected and soldered to a galvanized iron plate at least ⅛ inch thick and having an area of at least ten square feet on each side. If a pipe is used instead of a plate, the external area is not to be considered, but twenty square feet of external area is necessary. This earth plate should be sunk so deeply in the earth that even during a dry season it will always be in moist ground. A well or a stream of water is preferable. The earth wire should also be connected to water pipes or gas pipes if they are near by. Such a connection, however, is not a substitute for the earth plate, which is a necessity under any circumstances.

The conductor of the lightning rod of a building must not be connected with the earth wire of a lightning arrester.

All connections underground must be soldered and then painted with asphaltum to prevent corrosion and poor contacts. Poor connections with the earth are very often the cause of the unsatisfactory working of lightning arresters.

It should be borne in mind that no lightning arrester is an absolute safeguard against the freaks of lightning. Very long circuits, especially those not protected by tall buildings or trees, are very liable to be struck by lightning. In such cases extra devices at some points along the line must be put up as an additional protection.

The jaws of the lightning arrester should be kept clean and at a proper distance. It is advisable to run a cardboard between the plates every day to make sure that the jaws are at a proper distance from each other.

GROUND DETECTOR.—It is absolutely necessary to test electric light circuits frequently, and this means at least once a day, for grounds. In incandescent light installations which run

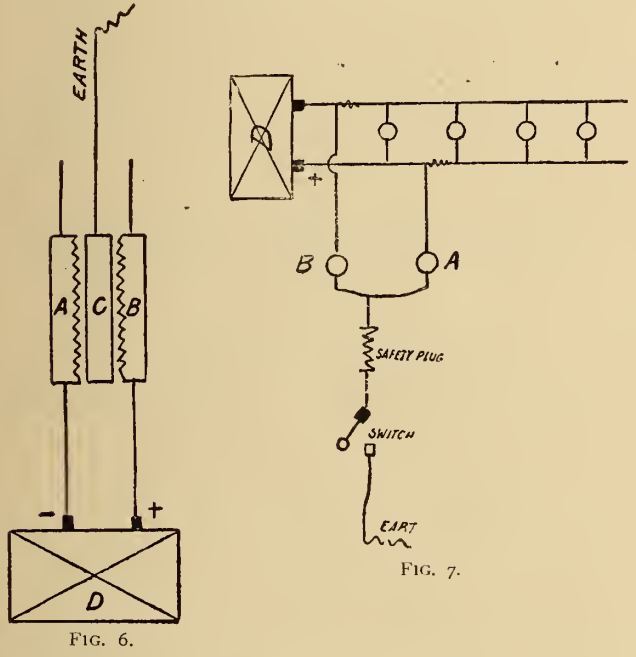


FIG. 6.

FIG. 7.

continuously, arrangements to indicate a ground while the dynamo is running should be made. A simple form of ground detector is shown in Fig. 7. Two lamps are connected in series between the mains near the dynamo. A wire leading to earth is connected between the two lamps or a safety plug and a switch are put into the earth wire. If there is no ground on the line the two lamps will burn very very dimly but at equal candle power. If a ground should occur anywhere in the circuit, say on the positive pole, the earth wire and the ground will form a shunt of low resistance to the lamp nearest the positive wire; the result will be that lamp *A* will dim down and lamp *B* will brighten up. Sometimes it may occur that both poles of a circuit are grounded and that the grounds are of about equal resistance. In such a case the two lamps will burn equally dimly. By switching out one lamp, however, it can be seen whether the lines are grounded or not. If the other lamp also goes out the lines are not grounded, but if the other lamp continues to burn the lines are grounded on both poles. To make this test one lamp should be provided with a socket with key.

Instead of two lamps a galvanometer with two coils connected in the same manner as the two lamps may be used. The needle will stand at zero when there is no ground on the line and deflect as soon as the wire gets grounded. Any grade of sensitiveness may be given such an instrument.

SWITCH-BOARD.—A switch-board is used in larger plants to connect any dynamo with any circuit. Of course only dynamos of the same kind can be made interchangeable. For arc lamp plants, plug switch-boards are generally employed. Short cables with a plug on each end can be inserted in the different

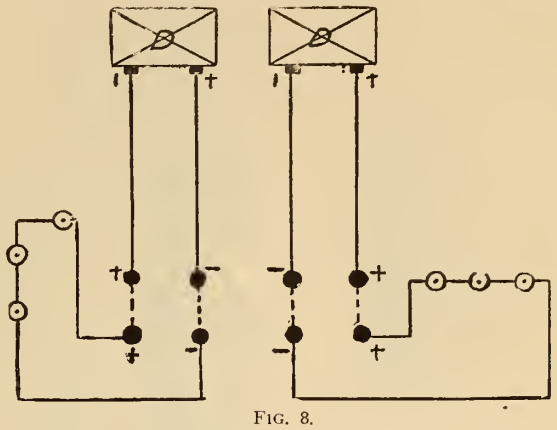


FIG. 8.

sockets. The latter are marked with + or −, and with *D* (dynamo), *C* (circuit). In addition, they are marked with a number. For instance, *D*1 (meaning dynamo number 1) can be connected to *C* 2 (circuit number 2), and so on. Fig. 8 is a diagram showing the arrangement of a switch-board.

In incandescent plants large lever switches are generally used, as large enough plugs could not be conveniently made to carry the heavy currents of incandescent circuits.

CIRCUITS OR LEADS.*

OUTDOOR LEADS FOR ARC LIGHTING.—The wire used for outdoor circuits is mostly what is called underwriters' standard. It consists of a copper wire which is braided with cotton and painted with asbestos to make it uninflammable. This wire is fastened to glass insulators on poles or houses in a way similar to that in which telegraph wires are usually run. Insulated wire, and not bare wire, should be used for tie wire, as the common non-insulated tie wire will cut the insulation of the line wire and possibly cause leaks. The size of arc light conductors varies between numbers 6 and 4, Brown & Sharpe gauge, number 6 being the smallest wire which can be used, according to the rules of the National Board of Fire Underwriters. If the return wire is fastened on the same poles, the positive and negative wires should be kept sufficiently far apart so they can not touch each other when swung by wind. It must be understood that the insulation called underwriters' standard is only an insulation when perfectly dry, and when wet is hardly any insulation at all. If, therefore, the positive and negative wires exposed to rain or moisture of any kind should come in contact with each other or with the ground, a short circuit would be caused. This may cut a number of lamps suddenly out and cause damage to the dynamo. Such an accident, for instance, may burn out the armature or throw off the belt. In very cold weather such occurrences are rare, as frost may make out of a circuit of the poorest insulation one of very high insulation, while on the other hand a thaw or rain may cause all kinds of disturbances. If these disturbance occur during a thunder storm accompanied by rain, lightning is often unjustly accused of having done the mischief, while in fact the poor insulation of the wires is the prime cause.

Accidents from poor insulation of lines are more frequent than damages caused by lightning, though the latter will always be a ready excuse for anything that may have happened. Recently weather and water-proof insulation have come in vogue, and they are much safer than underwriters' standard wire.

In conducting wires into houses, great care must be taken to prevent rain following the wires. The wire should be fastened to the insulator below the point where it is intended to be led through the wall or a window frame, so the rain would have to run up hill in order to follow the wire, Fig. 1.

Fig. 2 shows a wood pin and glass insulator, such as are used on cross-arms. The latter are fastened to poles by means of

* From "Dynamo Tenders' Hand-Book."

lag screws. Fig. 3 illustrates a wood bracket, which can be spiked to poles or houses and provided with a glass insulator. The glass insulators must always be fastened in a nearly vertical position, the closed end on top, so the space between the pin and glass insulator, Fig. 2, will remain perfectly dry in rainy weather and secure perfect insulation.

Fig 5 shows a rubber hook insulator. This should for the

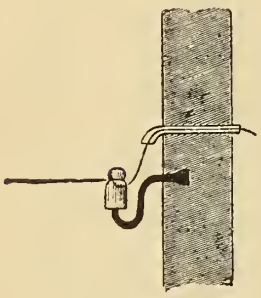


FIG. 1.

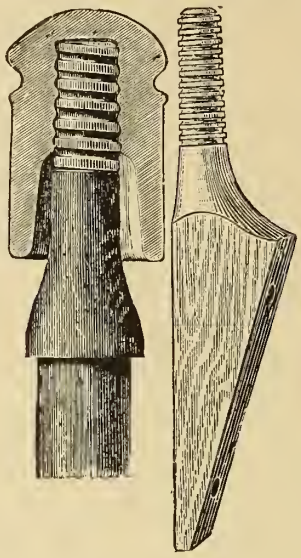


FIG. 2. FIG. 3.

same reason be fastened with the hook downward. A hole can be bored with a ⅝ inch bit underneath a cross-arm and the rubber hook screwed in with a wrench.

An extra heavy insulating material, such as rubber hose or hard rubber or porcelain tube, Fig. 4, must be put over the wires where they pass through walls or partitions.

Poles for lines should be set deep enough in the ground ; the

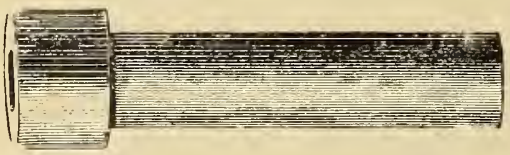


FIG. 4.

depth, of course, will depend upon the soil and the height of the pole. In sand, at least one-fifth of the length of the pole should be buried in the ground, while in rock one-tenth of the length is sufficient. In putting up wires, the season, or, in other words, the temperature, should be taken into consideration, allowing for contraction in cold weather. If, for instance, a wire should



FIG. 5.

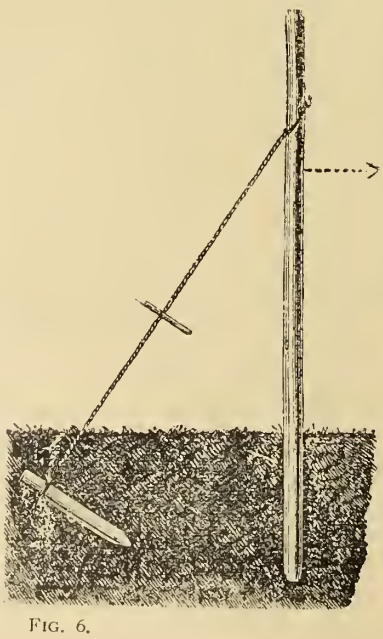


FIG. 6.

be put up very tight in July, it would cause a good deal of damage in breaking off glass insulators and pins as soon as the temperature fell to zero and caused the wire to contract. Corner poles must be braced or anchored to keep them in a nearly vertical position. See Fig. 6 and 7.

When a splice is necessary, it should be made after the fashion of the American telegraph splice, Fig. 8, and should be perfectly clean and solidly soldered and then well taped with insulating tape. In order to prevent the tape from peeling off, it is advisable to fasten the last turns of the tape to the wire with a few turns of bare copper wire, say about number 20. If this precaution is omitted the tape is sure to peel off in time. Most of our electric light lines will show places where the tape is hanging down a couple of feet. Besides, having no insulation

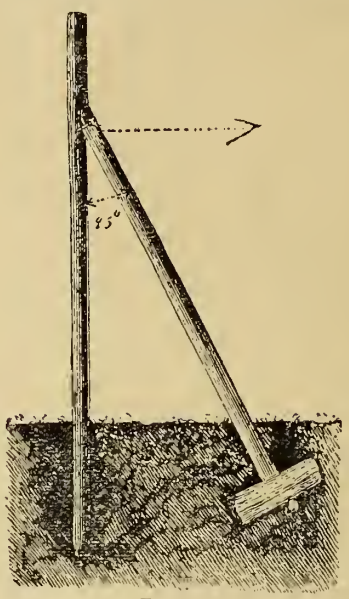


FIG. 7.

on the splice, this, of course, does not contribute to the beauty of overhead wires.

Brass line connectors, Fig 9, are only allowed for inside work where there is no strain on the wires. The set screws should be well tightened, and the connector be run full of solder and taped. Good soldering and taping of joints will save at least 50 per cent. of all the troubles that occur in an electric light plant. Joints should never be left unsoldered, even if persons who



FIG. 8.

claim to know all about it should think it unnecessary. The best apparatus for soldering joints on line wire out of doors is the gasoline blow-pipe, Fig. 10. Every trace of acid should be wiped off the wire with a moist or oily cloth before taping, to avoid corrosion.

OUTDOOR LEADS FOR INCANDESCENT LIGHTING.—The rules which were given for outdoor arc lines can be applied for incandescent light lines. As the wire used will very often be considerably larger than number 4 wire, the poles, cross-arms and other supports must necessarily be heavier to stand the greater strain, and poles should be set closer together. In a low tension incandescent system, very often bare wires are used,

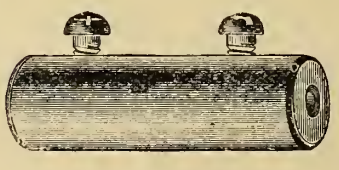


FIG. 9.

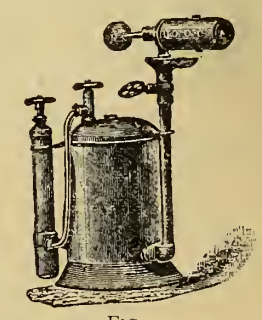


FIG. 10.

and still more care must be taken to prevent accidental contact of the positive and negative wires with each other or with the earth.

ARC CIRCUITS INSIDE OF HOUSES.—The wires for these circuits should be fastened to porcelain insulators, Fig. 11, and be exposed to view. Owing to the high tension which prevails in arc light circuits the concealing of these wires is not permitted by the underwriters. The directions given for splicing and insulating hold good also for inside wiring.

In rooms which are exposed to steam or moisture, as, for

instance, in packing houses, wire with a better insulation than underwriters, standard must be used. The moisture which covers insulators and wire would cause considerable leakage, and, besides, would corrode the wire. The use of wood cleats or iron staples instead of porcelain insulators should not be permitted in any case, as they are liable to cause grounds and, in fact, have been the source of mischief in a good many cases in years gone by.



FIG. 11.

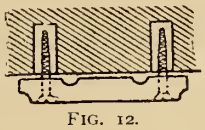


FIG. 12.

INCANDESCENT CIRCUITS INSIDE OF HOUSES.—In the low tension systems, wooden cleats or wooden molding are permitted ror fastening the wires to the walls and ceilings if there is absolute safety from moisture. Underwriters' wire may be used also under the same conditions. If there is any possibility of moisture getting to the wires, the latter should be first-class water-proof insulation. If any "fishing" has to be done, where wires are to be concealed under floors, above ceilings, or between walls or laths, only water-proof wire can be used. Incandescent wiring inside of houses requires a good deal of skill and experience, and should only be entrusted to reliable and responsible concerns. Unfortunately, any man who ever fastened a piece of wire for a bell-pull, thinks himself an expert also for incandescent wiring ; a good many even important jobs have been done by such men, with the result that, after a great expenditure of money by the owner of the house, the whole system had to be condemned, as not an inch of the wire had been put in properly and could be used.

The joints or connections in water-proof wire should be made water-proof also. This is done in the following way: After

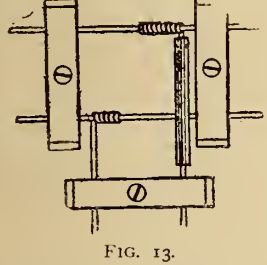


FIG. 13.

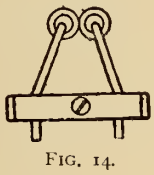
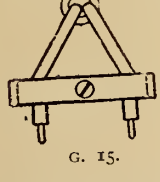


FIG. 14.

having spliced, soldered and cleaned the wires properly, cover the joint with hot Chatterton's compound by molding it between the fingers to almost the total thickness of the insulated wire. Then cover it with kerite tape and give it a second thin coating with hot compound, or hot asphaltum, and then give it a second coat of kerite tape. Hot liquid asphaltum should be used in lieu of compound where there is danger from sewer or illuminating gas that is prevalent in the soil and basements of houses in large cities.

Figs. 12, 13, 14, 15 and 16 show the use of cleats. Fig. 12 shows a familiar form of cleat. Where the positive wire crosses the negative, an extra protection of rubber tube is required to prevent any danger from short circuits, Fig. 13.



G. 15.

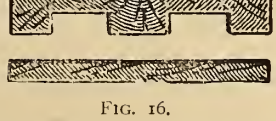


FIG. 16.

In passing through a wall, each wire should be inserted in a separate hole, lined with a hard rubber tube, Fig. 14, or each wire should be covered with soft rubber tubing and both may be drawn through one hole, Fig. 15, lined with a pipe of non-conducting water-proof material.

Fig. 16 is a cross-section of wood molding. The lower part is fastened to the wall or ceiling, the wires put in—positives in one groove and negatives in the other—and the cover screwed on. Care must be taken that nails or screws do not touch the wires.

The safety plugs are put in the circuit according to the rules of the fire underwriters. They must be of such size that they will fuse before the wire they have to protect can get dangerously warm.

SIZE OF WIRES FOR INCANDESCENT LAMP INSTALLATIONS.—The wire for each main or branch must be of such size that it can carry the current to the lamps which are connected to it, without getting very warm. The number of amperes a wire can thus safely carry is called its carrying capacity. The larger the wire the less the loss ; the smaller the wire the higher the loss. In house wiring not more than 5 per cent. loss should be allowed from the dynamo to the lamp.

For those who want to give this matter more study the following formulas are given. Any one who understands arithmetic will be able to calculate the size of wire for any loss and for any lamp :

n = number of lamps.

d = distance = ½ length of circuit.

% = energy lost in the conductors, expressed in decimal fractions of 100 as 5% = .05.

r = resistance in ohms.

1. r of wire $= \dfrac{r \text{ of lamp hot} \times \%}{n}$

2. Length of wire : 1000 = r of wire : r per 1000 feet.

3. r per 1000 feet of wire $= \dfrac{r \text{ of lamp hot} \times \% \times 1000,}{n \times 2 \times d}$

4. r per 1000 feet of wire $= \dfrac{\text{constant,}}{n \times d}$

5. Constant = 500 × % × r of lamp hot.

EXAMPLE : Find size of wire necessary to carry 40 sixteen candle power lamps (r = 167 ohms hot), 500 feet, 10 % loss.

Formula 5 : Constant = 500 × .10 × 167 = 8350.

Formula 4 : r per 1000 feet $= \dfrac{8350,}{40 \times 500} = .417$ ohms.

This is the resistance per 1000 feet of the wire necessary to use. If the resistance hot of the lamp should not be known it can be calculated from Ohm's law. $C = \dfrac{E}{R}$ or $R = \dfrac{E}{C}$. Supposing the e. m. f. = 100 volts and the current $= \dfrac{5}{10}$ amperes, R would equal $\dfrac{100 \times 10}{5}$, or R = 200.

TESTING.—The circuit should be tested every day for grounds by means of the detector galvanometer or a magneto bell. If a ground is indicated it should be speedily located by disconnecting the circuit in different places and taking each section separately, until the ground is located.

TRADE NOTES.

The contract for lighting the town of Lunenburg, N.S., has been awarded to the Edison General Electric Co. Plant to be installed is 750 incandescent lamps.

The contract for lighting D. W. Alexander's tannery has been awarded to the Edison General Electric Co. Plant to be installed consists of 180 incandescent lamps.

The contract for electric light plant at Merrickville, Ont., has been awarded to the Edison General Electric Co. Plant to be installed will consist of 500 incandescent lamps.

The contract for electric lighting at Niagara Falls, Ont., was awarded to the Edison Co. on Jan. 22nd. Eight different companies were competing. The contract was awarded to the Edison Company on its merits, as their price is said to have been nearly the highest of any of the tenders. The plant to be installed consists of 60 arc lights and 750 incandescent.

The Windsor Electric Light and Power Co., of Windsor, N. S., started up their Edison plant on Nov. 15th. 1,000 lights are installed and in operation, and giving such satisfaction that it has been found necessary to increase the plant, and an additional order for two Edison dynamos has been given to the Edison General Electric Co , which will give the plant a capacity of 1,600 sixteen c. p. incandescent lamps.

We had thought that the talented and versatile newspaper reporter had invented about all the possible causes of boiler explosions, but a new one comes from St. John, N. B., where a boiler exploded "with great violence" (as they nearly always do), killing six men and wrecking build-ings. The despatch says : "From what can be learned, the boilers were low, the water was turned on, and the person in charge neglected to turn it off, with the result that the boilers overflowed and exploded." From this it will be seen hat it is very dangerous to allow boilers to overflow.—*American Machinist.*

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The ELECTRICAL NEWS will be mailed to subscribers in the Dominion, or the United States, post free. for $1.00 per annum, 50 cents for six months. The price of subscription may be remitted by currency, in registered letter, or by postal order payable to C. H. Mortimer. Please do not send cheques on local banks unless 25 cents is added for cost of discount. Money sent in unregistered letters must be at senders' risk. Subscriptions from foreign countries embraced in the General Postal Union, $1.50 per annum. Subscriptions are payable in advance. The paper will be discontinued at expiration of term paid for if so stipulated by the subscriber, but where no such understanding exists, it will be continued until instructions to discontinue are received and all arrearages paid.

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EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

ANNOUNCEMENT.

WE desire to announce that the subscription price of the ELECTRICAL NEWS has been reduced from $1.50 to $1.00 per year. This has been done in order to make it possible for every person interested in electricity or steam engineering to become a subscriber.

The first number, notwithstanding its many imperfections, met with a flattering reception. Many kind things have been said of it in the press and elsewhere, for which we are grateful.

Subscriptions have been coming in during the month from all parts of Canada, and there is no reason to doubt that as the result of the personal canvass now being made the names of subscribers will soon mount up into the thousands. Those who have paid the rate of $1.50 have been credited with an additional half year. We desire to acknowledge the valuable assistance already received from the officers of the Canadian Association of Stationary Engineers.

Our advertising patronage shows satisfactory growth, and altogether, the outlook fully justifies our expectations concerning the future of this new enterprise. In view of such encouragement, no effort will be lacking to make the paper fulfil a useful purpose in the interest of every reader and advertiser. Let each reader who feels friendly towards the paper resolve that he will make some individual effort, however small, to advance its interests, and the results of such a combination of effort will not be long in manifesting themselves.

THE inconsistencies of public opinion have never been so strongly brought out as in the relative cases of accidental death by electricity and by the fumes of gas. If a careless and reckless lineman working amongst "live" wires and disregarding even the dictates of ordinary prudence, unfortunately meets with an accident which terminates fatally, the circumstance is proclaimed through the length and breadth of the land—the newspapers chronicle it with startling and sensational headlines, and call for summary vengeance on the person and property of the electric light people. But when a respected citizen in the peaceful pursuit of his everyday business, leaves his home and family never to return, having succumbed to the effects of the deadly gas served out at a dollar twelve and a half per thousand feet, these are the words found at the close of a six line paragraph in the local news of a city paper: "Coroner Johnson concluded that an inquest was unnecessary." Further comment is needless.

INQUISITIVENESS is a good thing if exercised within proper limits. Unfortunately it has in some degree come to be regarded as a characteristic worthy only of reprobation, because of its abnormal development in certain individuals. Few indeed there are so thoroughly posted as not to be in need of information on some subject appertaining to the profession or calling in in which they are engaged. Asking questions is one of the speediest methods of obtaining knowledge on any subject. We should be pleased therefore to receive and publish questions from our readers relating to subjects coming legitimately within the scope of this journal. Without laying claim to the possession of any extraordinary degree of knowledge, we nevertheless promise to exhaust all the sources of information at command in an endeavor to satisfy any demands for information which may be made upon us as the result of extending this invitation. The reward for any efforts put forth with this object would come to us in the interest and value to our readers which would attach to the publication of questions and answers of this character. Now bring on your questions!

THE incandescent light supplied from a well-equipped central station and by means of an exclusively underground system of mains and service pipes, may be looked upon as one of the most artistic and beautiful developments of the industry. Especially is this the case in the more modern edifices where the interior wiring is entirely concealed and the architectural and decorative details are made to conform and adapt themselves to the perfect illuminant. The glow-lamp lends itself in a peculiarly successful manner to the production of novel and charming effects. Whether in brilliant combination with reflecting mirrors and cut glass, or modestly peeping forth from the heart of a cluster of flowers, natural or artificial, there is a charm in the softness and steadiness of the light that is all its own. While for a time perhaps the cheapness of its smoky and noxious competitor may be detrimental to its general introduction, it is a fact not to be disputed that the cultured and æsthetic taste of modern society is creating a demand for it that is more than keeping pace with the supply. The advantages of the low-tension system of distribution in connection with underground mains are many and obvious. The difficulties are, that in a large city the demand comes from so many quarters that they cannot be reached as quickly as desirable, and would-be good paying customers are for a time left out in the cold; but this is only a temporary evil. The multiplication of central sources of supply will remove the difficulty, and the admirers of the modern illuminant will have the satisfaction of a perfect service when their district is reached as a compensation and reward for the exercise of the needful Christian grace of patience. Those who are not in a position by reason of distance to avail themselves of the coveted light, have the satisfaction of knowing that when it does come along they will have the advantage of all recent improvements and modern ideas. There are some fixtures for drawing room use that are a perfect dream of beauty, and every day adds to the number and variety. The low-tension system, while not so far reaching in its earliest inception as some others, still has advantages by reason of the means at command for keeping a supply of electricity in the mains at all times and seasons, irrespective of the difficulties that are inseparable from central station operations, even with the most perfect and approved facilities.

WE are glad to find that there is an increasing interest being taken amongst electric light men in our proposition anent the formation of an Electric Light Association in Canada. It is true that there is a similar association in the United States, but what is required is something distinctively Canadian. Electric light men as a rule are busy men, with scarcely leisure enough to keep track of the many improvements and developments being constantly made in their art. The meetings of the American Association being held anywhere from Maine to New Orleans, or San Francisco, are altogether too inaccessible to the modest and busy Canadian. The adoption, also, by our friends of the screaming eagle, of a higher and thicker wall of demarcation between the two countries, would seem to make it desirable that we should depend upon ourselves in a greater measure than formerly, and should seek as much as possible a community of interests that would render an entire commercial separation or

suspension of intercourse a matter of less injury to electric lighting interests. We are still dependent upon our neighbors to a certain extent, and it behooves us to look ahead a little and determine what can be done to best forward the interests of our industry. We are in receipt of communications from central station owners strongly advocating the formation of an association for purposes of mutual benefit, and shall be glad to hear further from any others on this point. It has been suggested that Toronto, being a central location, might be made the place of meeting for the inception of such an institution. Some time about or during the coming Industrial Exhibition might be mentioned as a suitable time. There is some talk of building a new Machinery Hall by the Association, in which, no doubt, there would be ample facilities and space for a first-class exhibition of electrical apparatus. Electricity has made rapid strides during the last year or two, and if it were made generally known that during the time mentioned electricians and electric light men would meet in conclave, special efforts would be made to centralize and exhibit all that is newest and best in electrical methods and appliances. The exhibition authorities would no doubt earnestly co-operate to make this branch of the Industrial a complete success. An association of this kind should consist of those engaged in the business of manufacturing and selling electricity from central stations. The annual fee might at first be made nominal—simply sufficient to cover ordinary working expenses, until such time as it would naturally extend and place itself upon a firmer basis. Let those who are willing to take a hand in the formation of such an organization and to become charter members, as it were, speak out, and that with no uncertain sound, and on our part we will do our utmost to give publicity to any correspondence or suggestions bearing upon the subject.

FOR a number of years the idea of providing the city of Toronto with water from Lake Simcoe has from time to time been brought before the public. At present the idea seems to be popular, and on the face of it, there seems much to commend it. The lake is a large one, and stands so high above the city that it is supposed the water would freely flow down and supply even the highest parts of the city with an ample supply at sufficient pressure for every purpose. No pumping would be required, and consequently there would be no expensive engines to buy, and to repair when they broke down, and no large coal bills to pay, in order to keep the pumps going. Such may be said to be the popular view of the gravitation scheme. The distance of Lake Simcoe from the city, about 40 miles, need not be considered as an insuperable difficulty. Water is now being brought to Manchester, Eng., by a conduit 96 miles long. Liverpool has one 67 miles long. Glasgow brings its water from Loch Katrine, a distance of 34 miles, and in that distance there are 70 tunnels, one of which is 600 feet below the surface of the ground. The supply to New York by the Croton Aqueduct is brought over 40 miles, and has a capacity of 115,000,000 gallons in 24 hours. With such examples there is apparently nothing unreasonable in suggesting that Toronto's water supply could be brought from Lake Simcoe. There are, however, other things to be taken into account. Lake Simcoe is the highest part of the fresh water supply filling the great lakes. It is higher than Lake Superior, consequently the supply to it is limited to the rain fall over a comparatively small section of country. Its natural outlet is to the north by means of river and lakes with a slow current, and the quality and quantity of water available for city supply are still unknown quantities. Between Toronto and Lake Simcoe the height of land passes, forming a high ridge running east and west. The ridge is so high that the water cannot run over it, and must be brought under it or through it. We do not know the exact figures, and until an exact survey is made possibly no one knows, but it has been stated that to get through the height of land involves a cutting over 11 miles long and from 200 to 300 feet deep, or making a tunnel. Then there are hollows to be crossed, which can be done by inverted syphons, but which increase the cost. The probabilities are that by the time a conduit has been built, it will be found that the interest on the outlay will amount to a much larger sum than the cost of pumping an equal amount of water from Lake Ontario. After all, probably the strongest reason why Toronto should not go to Lake Simcoe for a water supply is the fact that Lake Ontario is so near and contains an unlimited supply of water of the best quality, and which can be had for the pumping. If Glasgow, Liverpool, Manchester and New York could have obtained such water as we have in Lake Ontario on the same terms, the long conduits would never have been built.

WE publish elsewhere an epistle from the exponents of a storage battery who apparently take exception to our remarks on storage batteries in general. We should have been better satisfied if, instead of claiming superiority for their battery, they had shown or made an attempt to show in what respect it is superior to others in experimental use to-day. Wherein does the construction differ? Does the material used differ from others, and if so, what is the advantage of the difference? If the battery is covered by patent, there should be no hesitation in courting the fullest publicity on these points. The refusal of an offer of car, track, and motor to demonstrate its efficiency, is to say the least of it, curious. When it is well known, and has been so expressed by us that a successful storage battery is the El-Dorado of street railway men, that it is the crying need of the electrical world to-day, we should have thought that the proprietors of this bonanza would have jumped at the chance to show their goods without cost to themselves. This journal has no antagonism to any individual or industry. We aim to chronicle the progress of electrical science as it actually presents itself, and while of course we court the advertising patronage of our electrical friends, our highest aim is to make the ELECTRICAL NEWS of value to all engaged in electrical and engineering pursuits. To do this we intend to express our opinions of men and things without fear or favor, to chronicle events and discoveries as they actually present themselves, and to condemn the sharks who make use of a little smattering of electrical knowledge to make a raid upon the pocket books of the unwary in the name of science. By adopting a straightforward course and issuing a journal that can be depended upon, we shall increase our circulation to an extent that will make it necessary for any progressive concern to make use of its columns to reach the public. If we express opinions that to our readers may seem to be open to criticism, we shall be most happy to hear from them, and if we make a statement that appears not to be borne out by facts, and such is demonstrated to us, we will make full, public and complete recantation. We are proud to say, however, that during our publication of the ELECTRICAL, MECHANICAL AND MILLING NEWS from its inception till it gave place to the present paper, we have had no occasion for anything of the sort, but on the contrary, "coming events" have so plainly "cast their shadows before," that in every case changes and developments which are so rapidly taking place in this progressive science have been accurately and completely foreshadowed by us. We make no exception in this matter of the storage battery. We have expressed our opinions of it, knowing what we talk about. We have said that no imitations of those "not dead" perhaps, but simply "gone before," will ever solve the problem, and that success must be looked for on new lines. We are, however, more anxious that our increasing *clientele* should have the fullest information on what is doing and actual facts connected therewith, than we are for our own glorification, therefore we make this offer to the storage battery people in question: Produce fifty of your cells, place them in charge of an expert appointed by us and one by you for a thorough and exhaustive test, and the results shall be made public without fear or favor. You have the floor.

IT is announced that the Hon. John Costigan intends to introduce a measure during the next session of the Dominion Parliament, having for its object the appointment of a Government inspector of electric light. That is all right; there should be more inspectors. This country is not half enough governed. We need a few more officials to relieve the over-burdened producer of some of the superfluous shekels he has accummulated despite the harrassments and uncertainties of governmental interference. There is not enough risk in electrical investments at present even to make things interesting, so by all means let us have an electric light inspector; also let him have an assistant. Let there be a deputy assistant inspector and likewise a board of electric light inspection, with a chairman and secretary; also a vice-chairman and a few clerks, and charge up the expense

in the usual way to the victims, and if this does not knock out what life there is left in electrical enterprises, let the suffering country be divided into districts, after the manner of inspectors in general, and duplicate these barnacles on the ships of state until the precious craft gets waterlogged. There is also a crying need for an inspector of tallow dips and tin lanterns, for was it not one of these "in combination," as a patent lawyer would say, with Mistress O'Grady's cow that burnt down Chicago. Perish the thought that such a sultry fate should overtake anybody or any place in our young and glorious Dominion. Let us have inspectors appointed forthwith—inspectors of cows and deputy inspectors of tin lanterns. In plain words, this inspection business is overdone, even to the extent of trenching pretty severely on the liberty of the subject, and of becoming an hindrance to business and a means of driving it out of existence It is but too frequently an excuse for foisting upon the public purse a superannuated political hack so as to save him from arrest and imprisonment for having no visible means of support, and certainly results in increasing to the consumer the cost of the commodity "inspected." For instance, a notable specimen of municipal genius in Toronto is proposing to introduce a by-law to compel every load of coal sold in the city to be weighed on the public scales. He is gunning for popularity by imagining that he is after the scalps of the bloated monopolists of the coal ring, but his brilliant intellect must have flown off the handle this time. The cost of hauling to the scale and going back after delivery to weigh the empty cart—say fifty cents per load—must of necessity come out of the pockets of the purchaser, with the ultimate result of a tax on the community to pay for more civic pensioners to engineer a further supply of city scales. In the case of the electric light we do not see how it is possible for any standard to be maintained. In every town in the province of any size, there is an electric light plant, frequently two. The current standard of each is different, and unless the machinery is thrown away and new substituted, must remain so. The owner offers to a store keeper or a business man his electric light and asks for it a price commensurate to its size or the hours used—so much per night or per month as the case may be. Nobody is compelled to take it, and if it does not suit they are not long in throwing it out. There are inspectors of gas simply because there are different *qualities* of gas, some bad, some worse, and some villianous, but the Government says nothing about the *quantity* ; that is left as a *casus belli* between the consumer and the gas company. There is only one *quality* of electricity, that has yet been brought to our notice, and it is an invariable and unchanging unit, why, therefore, is it necessary to appoint an inspector to determine the quantity? That should be left as a matter of bargain and sale between the producer and consumer. If the intention of the Government is to establish a standard in candle power of certain currents and voltages by which arc lamps may be technically known to the trade, well and good, but the light under similar conditions of current and electromotive force may vary so much from the carbons employed, the state of the atmosphere and unavoidable momentary alterations of conditions in the central station apparatus and the delicate mechanism of the lamp, that an absolute and unvarying standard would become an impossibility. To meet the temporary disability caused by a slipping belt, an over-heated armature or a defective lamp, the customer usually makes a point of claiming a rebate for the shortage in quantity, and owing to the absence of ability to store electricity or keep a quantity in hand as it were for emergencies, this item of rebates is considerable with most stations, and is usually provided for in the contracts. All the inspection in the world will not prevent the broken belt, the temporary disarrangement in the mechanism of the steam engine or the crossing of some vagrant bell wire with the aerial circuit outside. If a Government official can produce an infallible panacea for these evils, electric light companies would hail his advent with pæans of thanksgiving, but being only mortal, and probably a poor specimen at that, his office would simply become an elegant sinecure at the expense of his more industrious and practical fellow-men.

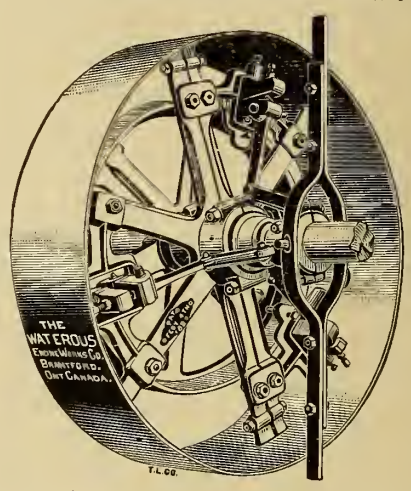
THE attention of engineers is directed to the particulars of a competition printed in another part of this paper. The publisher of the NEWS with the object of stimulating research on the part of engineers in charge of steam plants throughout Canada, offers prizes in cash for the solution of certain problems in steam engineering. It will be noticed that this competition has been limited to those actually engaged as operative engineers, and the questions are such as every competent engineer should be capable of answering. Should satisfactory interest be manifested in this competition, others designed to serve a like object will be announced from time to time in the future.

FRICTION CLUTCH PULLEYS.

FRICTION clutch pulleys are designed to supersede tight and loose pulleys, drop tightners, etc., and to avoid the unnecessary work and consequent wear imposed by them upon belts while the machinery is idle. They are extensively used in electric lighting and are very desirable when frequent or abrupt stoppage of machinery is necessary. They are being very expensively adopted in mills and factories of every description, and are especially suitable for high speed service and heavy work. The friction rim only is keyed to the shaft; the pulley and grip mechanism is free or loose thereon. Therefore, when not "in grip," the driving pulley remains motionless, while the shaft revolves freely in the babbitted pulley sleeve. Immediately upon being gripped the power is transmitted to the pulley through the grip and ring. When the grip is attached to the driven pulley (located on machine or counter shaft) the pulley revolves freely upon the shaft until the clutch engages with it and causes it to drive the shaft.

The accompanying cut shows a friction clutch pulley made by the Waterous Engine Works Company, of Brantford, Ont. It is claimed to be simple, compact and durable, engages and disengages gradually, thereby preventing any possible injury. The operation of this friction grip pulley and friction grip cut off coupling will be understood from the followiug description.

The grip ring or rim, instead of being cast to the arms of the pulley, as in ordinary clutch pulleys, is a pulley by itself, securely keyed or fastened with set screws to the shaft transmitting the power, or in the case of a driven pulley, to which the power is transmitted. The grip mechanism is



fastened to the arms of the pulley or coupling. In the case of a pulley, the friction rim is made about half the diameter of the pulley. In operating the pulley or coupling, this grip mechanism stands motionless when the pulley is not driving or when the connected shaft is cut off. To bring it into work, the sliding sleeve on the shaft "D" is forced with a lever toward the friction pulley rim, and readily passes beyond the diametrical centre or grip arms, which causes two, four or six sets of friction grips to grasp the rim with an irresistible, vise-like grip.

From the peculiar mechanism of the grips it will be readily seen that the pressure of the inside and outside jaws upon the friction rim is always exactly equal. When desired, the power may be applied by degrees and the pulley started gradually, or the sliding sleeve can be thrust in instantly by a quick movement of the shifter, when the pulley or coupling immediately starts at full speed. The friction grips are adjustable. The end of lever is of cast steel, tempered, and engages a small block of cast steel, tempered, let into the under side of top grip arm. This steel block is adjustable, being hung from the inner end and adjusted by a set screw working from the upper side of grip arm. By this means, any strain desired can be put on the frictions to take up the wear of the friction shoes. The friction shoes are shod with thoroughly seasoned maple, set end on to their work, and will wear many years. The maple is easily renewable, and requires no oiling. When the sliding sleeve is withdrawn, the point of lever engaging the steel block in grip arm at once works into a recess formed in the steel block to receive it, and permits top grip arm to leave pulley, releasing immediately the grip from the friction rim. All parts subject to wear are renewable at a very slight expense, and without trouble or loss of time, it being unnecessary to remove the pulley from the shaft in order to renew or adjust any worn parts. There is absolutely no contact or frictional surfaces when not in grip. Owing to the short travel of the sliding sleeve, and the fact that it passes the diametrical centre of grip arms, the operation of gripping and releasing is so easy that it can be readily accomplished, and when once the sleeve is thrown into position there is no strain upon it whatever, nor can it possibly get out of grip without being forced by the lever. When desired, these friction grip pulleys and cut-off coupling can be promptly brought to a standstill, even when running at a high rate of speed. This in case of accident may prevent much damage or perhaps loss of life. For furthers particulars address the manufacturers.

ENGINEERS' COMPETITION.

THE publisher of the ELECTRICAL NEWS invites engineers throughout Canada to compete for the solution of the following problems:

1. What is a horse power as applied to a boiler?

2. How much is gained if feed water can be had at 120° temperature instead of 40°?

3. With water at 40° fed into the boilers, and steam taken off at 90 lbs. pressure, how much coal should be required for each thousand gallons of water used?

4. What would be the safe working pressure for a horizontal tubular boiler, 64 in. diam., 14 feet long, with 90 tubes, 3 in. diam., shell made of 60,000 lbs. steel plates ⅜ in. thick, and double rivetted in longitudinal seams?

5. Give size of furnace for soft coal for such a boiler, and size of smoke pipe, and area and height of chimney for a range of six boilers of same dimension?

6. An engine has cylinder 18 in. diam. and 18 in. stroke, and makes 240 revolutions per minute. Steam is supplied at 90 lbs. pressure in boilers, 30 feet away. What size should steam pipe be?

7. With steam cut off in above engine at ⅛ in. of the stroke, and discharged into a heater open to the atmosphere, what horse power can be got?

8. If a condenser be added, maintaining a vacuum of 26 in. on the gauge at the condenser, what *additional* power could be got from engine?

9. What difference to the amount of fuel per horse power per hour should there be between above engine using a heater giving water at 190° and using a condensor, maintaining a vacuum of 26 in., and supplying feed water at 100°?

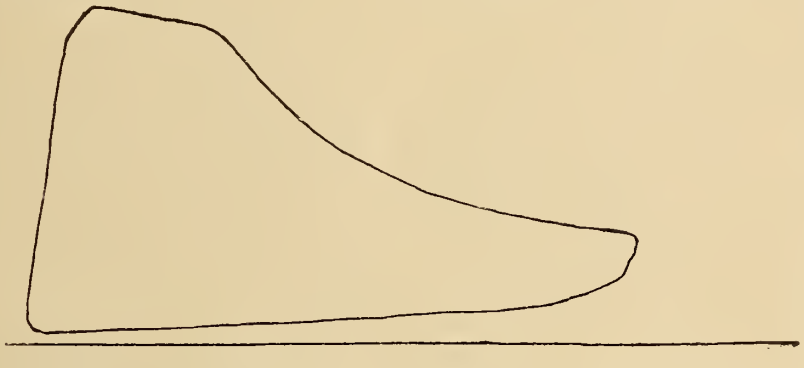
10. If engine speed varied while the pressure of steam and load were constant, what should be done to remedy the defect?

11. In a high speed automatic cut-off engine, what is the effect of the weight of the reciprocating parts on the steadiness of motion?

12. The duty of the governor is said to be to regulate the speed; upon what conditions does its power to regulate depend?

13. What are the advantages of "compression" in the steam cylinder?

14. Describe the defects in the annexed diagram, and state what should be done to remedy them.



Cash prizes of $15 and $10 respectively will be paid to the competitors whose answers to the above questions shall be found by the judges to be deserving of the highest number of marks, and who shall have complied with the undermentioned conditions.

CONDITIONS OF COMPETITION.

1st. Competition is open only to subscribers to this journal actually engaged in the charge of steam boilers or engines within the Dominion of Canada.

2nd. Answers must be received at the office of the ELECTRICAL NEWS, not later than April 15th, marked "Engineers' Competition."

3rd. The answers will be judged and marked by points, in accordance with the merits of each.

4. Allowance will be made for neatness of writing, etc., as well as for correctness of answers.

5th. As a guarantee that answers are from the men intended, each competitor must send with his paper the name and address of his employer.

Messrs. Geo. C. Robb, Chief Engineer of the Boiler Inspection and Insurance Co., Toronto, and Mr. A. M. Wickens, ex-President Toronto Branch No. 1, Canadian Association of Stationary Engineers, have kindly consented to act as judges in this competition, and their decision will be final.

PUBLICATIONS.

The first number of a new trade paper entitled *The Canadian Dry Goods Review*, published monthly at Toronto by the Dry Goods Review Co., is received. It is very creditable to the publishers. We wish the new comer a long and prosperous career.

We have received the initial number of the *Canadian Miller*, published monthly by Mr. A. G. Mortimer, Canada Life Buildings, Toronto, price $1 per year. *The Miller* consists of 22 pages of matter well calculated to interest and instruct those engaged in the milling, grain and flour trades.

The February *Arena*, in addition to a brilliant array of American authors, presents two papers of great interest by foreign essayists. Camille Flammarion, probably the most eminent European astronomer, writes at length on "New Discoveries on Mars." His paper is accompanied with a full-page geographical map of this wonderful star, as prepared by Flammarion and other leading astronomers. It also contains two small maps illustrating strange changes that have recently taken place on one portion of Mars. The distinguished Frenchman's paper in the short compass of sixteen pages gives the busy reader the important astronomical discoveries of recent years in a nutshell.

RECENT CANADIAN PATENTS.

No. 35554. A. Davis, Elevated electric cable.
No. 35561. J. E. Wilson, Steam boiler.
No. 35572. C. J. Van De Poele, Electric conductors.
No. 35575. S. Thring, Water gauge.
No. 35584. C. J. Van De Poele, Reciprocating elec. eng.
No. 35585. " " " " "
No. 35586. " " Railway train system.
No. 35587. " " Conduit for electric conductors,
No. 35594. W. Kinsley, Belt fastener.
No. 35599. N. H. Edgerton, Steam engine.
No. 35618. C. D. Howard, Draft regulator.
No. 35639-19. G. A. Sanders, Electric gas lighters.
No. 35610. H. Gilmore, Tube cleaner.
No. 35647. J. G. Gamgee, Steam boiler.
No. 35672. G. W. Dryden, Pulley.

NOTES.

Messrs. Connell Bros., of Woodstock, N. B., are about to engage in the manufacture of steam engines.

It is proposed to incorporate as a limited liability concern, with a capital stock of $700,000, the well known manufacturing firm of Goldie & McCullock, of Galt, Ont.

On the 28th inst., the Manager of the Edison Company at Toronto received the following telegram from Winnipeg: "First Edison Canadian electric car has started. We send congratulations. A grand success." The despatch was signed by Mr. A. W. Austen, Manager Winnipeg Street Railway Co.

Letters of incorporation have been granted the John Doty Engine Co., of Toronto, (Ltd.), with a capital stock of $250,000. The members of the Company are: John Doty, Franklin Henry Doty, Frederick William Doty, Daniel Hunter and John Franklin Walshe, all of Toronto.

The engines of the Steamers Spartan and Corcian, of the Richleau & Ontario Navigation Line, are to be compounded and new boilers are to take the place of those heretofore in use.

A cement for leaky boilers (steam or hot water) consists of two parts of powdered litharge, two parts of fine sand, and one part of slaked lime. Mix with boiled linseed oil and apply quickly.

A cheap and efficient lagging for steam pipes can be made out of some of the waste products of paper manufacture. The waste products in question are chiefly those coming from the different cleaning and sorting machines which are of a fibrous nature. When dry they are mixed with potter's earth in the proportion of four to one, enough water being added to make a plastic compound. This is spread by hand over the surface to be protested in thin successive layers. When dry the coating is said to adhere firmly, and it has additional recommendation of entailing no greater cost than that of mixing and applying it.

A deputation representing the Coal Importing Association and the Board of Trade, Montreal, waited on the Minister of Marine and Fisheries a few days ago and asked for the abolition of the existing system of boiler inspection on vessels carrying coal from Nova Scotia to Montreal, on the ground that the delay of 48 hours necessary for inspection causes great loss, and that British competition is thereby shut out, as the English vessels hold that Lloyd's inspection should be sufficient and refuse to submit to the Canadian regulations.

CHIGNECTO MARINE TRANSPORT RAILWAY.

THE Canadian Locomotive and Engine Co., of Kingston, Ont., have kindly furnished us with the following particulars regarding the tank locomotive with eight coupled wheels, no truck, at present in course of construction at their works for the above railway:

Two of these locomotives abreast are to haul vessel on cradle 17 miles on a level and straight track at a speed of (10) ten miles an hour. Weight of cradle and vessel 2,500 tons (of 2,240 lbs). Cradle carried on 120 four wheels trucks. Steel rails, 110 lbs. per yard; cylinders, 22" diam., 26" stroke; driving wheels, 47" diam., outside tyre; boiler working pressure, 175 lbs. per sq. inch; boiler, straight top, 59" diam.; tubes, 2" diam. Heating surface, 256 tubes, 1,741 sq. ft.; firebox, 137 sq. ft.; total, 1,878 sq. ft. Grate area, 29 sq. ft. Total weight (all on drivers), 180,000 lbs., in working order. Capacity of tanks, 3,000 imp. gals. = 3,636 U. S. gals.

A TOKEN OF APPRECIATION.

TORONTO, Jan. 19th, 1891.

Editor ELECTRICAL NEWS.

DEAR SIR,—I have pleasure in advising you that at the last regular meeting of Toronto Branch No. 1 of the Canadian Association of Stationary Engineers, the following resolution was unanimously adopted :

"That the members of this Association do hereby tender you a hearty vote of thanks for your kind liberality in advertising our Association in the late ELECTRICAL, MECHANICAL AND MILLING NEWS and also in the ELECTRICAL NEWS AND STEAM ENGINEERING JOURNAL. The Association recommends the journal to all engineers and mechanics, believing it to be a good medium through which to obtain information."

Wishing you every success, I am, dear sir,

Yours truly,

W. G. BLACKGROVE,

Secretary.

STEAM BOILER TESTS AS A MEANS OF DETERMINING THE CALORIFIC VALUE OF FUELS.*

BY D. W. ROBB, AMHERST, N. S.

IT will be recognized by those who use large quantities of fuel, especially of bituminous coals, that they differ very greatly in value, even coals which are taken from adjoining areas give very different results, so that it is sometimes very puzzling to the consumer and difficult to decide upon the merits and proportionate values of the fuel within his reach. It is likewise difficult to determine when the greater practicable amount of work is being obtained from the fuel, and consumers are frequently subjected to great loss from the want of this knowledge. There are three recognized methods of determining the calorific value of fuels, viz.: by chemical analysis, by the use of calorimeter, and by actual measurement of the water evaporated by a definite amount of fuel in a steam generator. By the first method, it is possible to ascertain the constituents of the fuel in their various proportions, and to determine the theroetical heat value when combined with a definite proportion of pure oxygen, and approximately to compute the amount of heat which would be converted into work when combined with ordinary air, and consumed under usual conditions. But this becomes a complicated problem, as will be seen when it is considered that the heat absorbed and wasted in heating the non-combustible constituents of both the air and the fuel must be taken into account, and that these wastes vary with the amount of superfluous air admitted through the grate, and with the proportion of non-combustible matter in the fuel; therefore, any estimate of the practical value of a fuel deduced from chemical analysis can only be approximate. In testing fuels by a calorimeter, a sample of the fuel mixed with chlorate of potassium is placed in an open mouthed copper vessel, which is submerged open mouth downward, like a diving bell, in a vessel containing a measured quantity of water. Combustion of the fuel takes place and the heat produced is absorbed by the water, the the total quantity of heat being determined by the rise in temperature of the water. This method has some advantages over an analysis and, if care is exercised in the selection of samples to be tested—or a large number of samples tested—is perhaps the best means of establishing a theoretical standard calorific value of a fuel, but the quantity tested is necessarily small and may not fairly represent the fuel ; it also leaves out the heat absorbed by the non-combustible portions of the air and fuel, which is an important factor in the combustion of fuel, under ordinary conditions. The method by which the fuel is consumed under actual conditions and in large quantities in evaporating water in a steam boiler, is generally regarded as a test of the efficiency of the generator, rather than as a test of the value of the fuel, but somewhat extended observation of the performance of various steam generators using similar grades of coal has convinced the writer that the steam boiler test, when properly conducted, is quite as valuable as a means of determining the calorific value of fuel, and of comparing various fuels as for finding the efficiency of the generator ; in fact, the latter is the more uncertain of the two, because, unless a boiler is tested with a fuel of a known calorific value, it is impossible to arrive at its actual efficiency or to compare it fairly with any other form of generator. In testing the heat value of fuel in an ordinary steam boiler two elements of uncertainty are introduced, viz., loss through imperfect combustion of the fuel, and the escape of gases at a higher temperature than the atmosphere, but as these losses, as well as the heat absorbed by the non-combustible portions, the air and fuel, are unavoidable in the present state of science, they should be taken into account in making a practical test of fuel, and strict accuracy only requires that the loss be uniform and minimum in result. Practical experience teaches that almost perfect combustion may be attained in any of the common forms of steam generator by careful and regular stoking with a proper air supply ; and, that the skill necessary to produce this result is possessed by many ordinary stokers, who have no knowledge of the laws which govern the combustion of fuels, will doubtless be admitted by many persons who have observed locomotive firemen or others, who are compelled to get a high rate of steam production. It is of course impossible to transfer all the heat produced in combustion to the water in a generator, because the gases cannot be reduced below the temperature of the water or steam within the generator, and a certain temperature above the atmosphere is necessary to produce draught in the chimney, but it is quite possible to so proportion the grate surface to the heating surface of the boiler that the gases will be reduced to a certain minimum temperature, and maintained at that temperature during a test. The temperature may be indicated by a pyrometer or high registering thermometer at the base of the chimney, and the rate of flow of the gases may be ascertained by the use of a draught gauge.

Frequently an attempt is made to analyse waste gases, this gives an uncertain result on account of the difficulty of getting representative samples of the gases, but from observation and examination of many tests the writer believes it unimportant, if the stoking and air regulation receive proper attention. The surface of the grate should be so proportioned to the heating, or heat absorbing surface of the generator that the gases will, when they reach the uptake, be reduced to say 400° Fahr.; the skillful firing and air regulation will produce practically perfect combustion and uniform temperature. It is not of so much consequence either, as some people imagine, what kind of generator is used. The brick furnace is supposed to possess an advantage in maintaining the temperature necessary to perfect combustion, while contact with the cooler surface of a water lined furnace is supposed to prevent ignition of the volatile hydro-carbons coming from some fuels, producing carbonic oxide; but the writer is convinced that, by a proper regulation of the fire, so that the air will pass through and the gases will pass over a bed of hot coals, or incandescent carbon, with frequent and even distribution of the fuel, as perfect combustion may be, and is obtained in a water lined furnace as in a brick one. The water lined furnace avoids the radiation of heat and admission of air, both of which are an uncertain but certainly wasteful feature of the brick furnace.

Steam boiler tests, although attended with some difficulty, are quite within the reach of ordinary consumers, and deserve to be better understood and used more than they are. In addition to their value as a method of determining the heating properties of fuel, they furnish the best possible means of ascertaining the condition and efficiency of the generator, and of checking, and if necessary correcting waste on the part of the stoker. It is desirable that such tests should be made frequently, because steam boilers are very liable to deteriorate and become wasteful, especially when set in brick, through the cracking of the brick walls, as well as by the coating of heating surface with scale or other deposits on the inner, and soot or ashes on the outer surfaces. It is quite practicable for steam users to have tests made by their engineers and ordinary assistants, but it is preferable to have an occasional test made by a professional engineer who has had experience in making such tests, as he will have gained special knowledge which will enable him to detect and locate imperfections in the generator more readily than those unaccustomed to such work. The writer would suggest to steam users the following practice : That one or more tests be made by an expert to determine the efficiency of the generator, and that he may direct any necessary repairs or corrections in the generator. After this has been done, and a standard of efficiency established, a good water meter should be inserted in the water supply pipe, so that a record of the water used may be continuously kept, and the stoker or engineer should keep a log and make daily reports of the coal consumed and the water

* A paper read on Dec. 8th, 1890, before the Nova Scotia Institute of Science, Halifax, N.S.

evaporated. The meter readings will need correction, if absolute accuracy is desired, but for practical purposes this may not be necessary. It may seem like unnecessary labor and expense to weigh all the coal used, but a short trial will undoubtedly prove its value, as it will not only indicate, constantly, the condition of the generator, but to a certain extent, be a check upon the working of the engine and the amount of power used by the establishment, and it will furnish a constant incentive to the engineer, stoker, and those in charge of the steam machinery, to improve its working and reduce the amount of fuel consumption to its lowest limits. A general practice of this kind throughout the country would induce a rivalry in the saving of fuel, parallel to that found in marine practice, where it is claimed a horse power is produced by from one and a half to two pounds of fuel per hour, instead of four to ten pounds—the last named quantity being not uncommon in ordinary steam plant, and would in the course of a few years cause an enormous saving to the country, as well as to individual consumers. Rules governing the standard system of boiler trade, adopted by the American Society of Mechanical Engineers may be found in the transactions of that Society, vol. vi, 1884. The following simple instructions will enable any steam user to conduct a test of his boilers for the purpose of comparing the values of fuels, etc., after the efficiency of the generator has been established by a complete test by an expert, (observations of the quality of steam, strength of chimney draught and analysis of gases are omitted, as they require special instruments and skilled manipulation).

INSTRUCTIONS FOR CONSUMERS' TEST.

A test to be of any value should be continued for not less than ten hours, and will require the constant attention of not less than four persons besides the regular attendants, appointed as follows :—One or two men to weigh the coal, and one or two to attend to and weigh the water ; one clerk to keep the log of the coal and water weighed, and one clerk to record the pressure of steam, temperature of feed water, temperature of chimney gases, and to keep a gross account of the coal and water as a check to the regular log. These should be careful men, well posted as to their duties. Three good platform scales will be required, and two tanks, or clean tight casks, to weigh water in. Preparation should be made so that the water can all be delivered into the two tanks, which are placed upon two platform scales, and the water pumped alternately from the tanks to the boiler. A piece of hose attached to the suction pipe of the pump or injector will be convenient to transfer from one tank to the other. It will be advisable to procure from reliable instrument makers one or two accurate thermometers for the purpose of taking the temperature of the feed water and chimney gases. The temperature of the feed water should be taken by inserting a brass or copper cup in the feed pipe near its connection with the boiler. This cup may be filled with oil and the thermometer set in the oil. The temperature of the cold water before it enters the injector or feed water heater should also be taken. Great care should be exercised that all scales, steam gauges, etc., are correct, and that there are no leaks about the pumps, pipes or boiler, by which any water may escape without being evaporated. Steam leaks are not material except as misrepresenting the consumption of the engine. The temperature of escaping gases may be taken by inserting a brass or copper pipe, with closed end in the smoke connection where it leaves the boiler. This cup, which should reach the centre of the escaping gases, may be filled with oil and a high registering thermometer placed in it. Previous to the hour for starting, say 6.30 o'clock, steam should be up to the working pressure and the tubes and all surfaces and flues should be swept clean. The ash pit should be cleaned and the first charge of kindling and coal, or the fuel to be used, should be weighed, every man should be at his post, those who are to note the various readings provided with ruled forms for recording the gross, tare and net weights of fuel and water, and others for the pressure of steam, temperatures of feed-water and escaping gases, which should be noted every quarter hour. At the hour for starting the height of the water in the boiler should be marked on the gauge glass, so that it may be brought to the same place at the close of the test, and the fire should be drawn quickly and replaced with the weighed kindlings and fuel, (wood kindlings are generally taken at 4-10 the value of coal by weight). The working of the boiler may be conducted as usual in every way, the stoking should be done carefully, so that no waste may occur through dead spots or holes in the fire, or uneven distribution of fuel. If the fire is too thick, some of the gas will pass off unconsumed for want of sufficient air, and if the fire be too thin, too much air will be admitted. The draught or air supply should be regulated by the ash pit doors or registers, and an even fire and steady pressure of steam maintained throughout the test. If work is to be suspended at mid-day, or any time during the test, the drafts may be closed, the fire banked, and an attendent left in charge who will regulate the fire if necessary, so as to keep the pressure constant. At the close of the test the water should be brought to the same level in the boiler as at the beginning and the fire withdrawn and deadened quickly with water. The remaining coal should be weighed and deducted from the quantity charged to the boiler, and the ashes may also be weighed. The net weights of coal and water may then be summed up and the result of the test ascertained and recorded in the following manner :—

Test of boiler at day of	18
Kind of boiler	
Dimensions	
No. tubes	
Size of fire-box	
Grate surface	sq. ft.
Heating surface	do
Height of chimney	
Size of chimney	
Duration of test	hours
Kind of fuel	
Boiler pressure (by guage)	lbs.
Temperature of feed-water entering boiler	degrees Fahr.
Temperature of feed-water entering pump or injector	degrees Fahr.
Temperature of escaping gases	degrees Fahr.
Total fuel consumed	lbs.
Percentage of moisture in fuel	per cent.
Equivalent dry fuel	lbs.
Total weight of ash	lbs.
Equivalent combustible	lbs.
Total water evaporated	lbs.
Water evaporated per hour	lbs.
Water evaporated per pound of dry fuel	lbs.
Water evaporated per pound of dry fuel from and at 212°	lbs.
Water evaporated per pound of combustible from and at 212°	lbs.
Horse power developed.	

The above particulars are determined in the following manner :—The pressure of steam and temperature of feed-water and gases are taken from the average readings of the same.

The total quantities of fuel, ash and water are taken from the net summing of log, great care being taken that no error is made. The percentage of moisture in fuel is determined by drying a sample of the fuel for 24 hours and getting the difference between the wet and dry weights, which difference is multiplied by 100 and divided by the weight of sample before drying.

The equivalent dry fuel is found by multiplying the total quantity of fuel by the percentage of moisture and dividing by 100, which is deducted from the total quantity of fuel.

The equivalent combustible is found by deducting the total amount of ash from the total quantity of fuel.

The water evaporated per hour is the total quantity of water divided by the number of hours duration of test.

The water evaporated per pound of dry fuel is the total quantity of water divided by the total quantity of dry fuel.

The water evaporated per pound of fuel from and at 212° is found by multiplying the water evaporated per pound by the total heat, or heat units, on one pound of steam at the average pressure, less the total heat of one pound of feed water at the average temperature of feed water before entering the pump or injector, and dividing the product by 966, which is the total heat in units, of one pound of steam at 212°.

The horse power is determined by deducting the total heat units of one pound of feed water at the average temperature before entering pump or injector, from the total heat units of one pound of steam at the average pressure, and multiplying the product by the quantity of water evaporated per hour and dividing by 110.343 (which are the heat units required to raise one pound of water from 100° and evaporate it at 70 lbs. pressure),

the quotient should be divided by 30, which will give the horse power according to the American standard. The following is an example of this method of finding the horse power :

Total quantity of water evaporated = 2,000 lbs.
Steam pressure (by gauge) 60 lbs.
Temperature of feed water before entering pump, 40°
Total heat of 1 lb. of steam at 60 lbs. pressure = 1175,710 B.T.U.
Total heat of 1 lb. of feed water at 40° = 8 B.T.U.
1174.710—8 × 2,000 ÷ 1110.343 = 210.33 ÷ 30 = 70 H. P.

Example of finding the equivalent evaporation from and at 212°.
Water evaporated per lb. of fuel, 10 lbs.
Average pressure by gauge 60 lbs.
" temperature of feed water, 40°
Total heat of one lb. of steam at 60 lbs. pressure, 1175.710 heat units.
Total heat of one lb. of feed water at 40°, 8. heat units.
Example : 10. × 1175.710—8. ÷ 966 = 12.08 lbs.

In comparing fuels as well as in comparing the efficiency of boilers, the quantity of water evaporated per pound of fuel from and at 212° should always be used. The actual quantity of water evaporated per pound of fuel will differ with variations of temperature of the feed water entering the boiler, and also with the steam pressure or temperature at which the steam leaves the boiler, but the quantity evaporated per pound of fuel from and at 212° allows for these variations and gives a true comparison of the value of fuel if the efficiency of the generator is constant, or of the efficiency of the generator if the calorific value of the fuel is known. The temperature of saturated or dry steam always corresponds with the pressure, but if from any cause the steam be not dry, it will carry away less heat in proportion to weight, or, if the steam be superheated by contact of the products of combustion with the steam surface of the boiler, it will carry away more heat. In either case the result of the test will be vitiated unless the quality of the steam be ascertained and accounted for. This is usually done by means of a calorimeter, one of the best of which, known as the "Barrus Calorimeter," was designed by Mr. Geo. H. Barrus, of Boston. No attempt has been made to ascertain or account for the quality of steam in the simple test given, because it would complicate the work ; it is intended that a professional test of the boiler should include this important item, and, if the boiler is found to be abnormal in this respect, the expert should either give directions for the removal of the cause, or provide a formula for the correction of the error due to wet or superheated steam in future tests.

The following table will be found useful in ascertaining the equivalent rates of evaporation, horse power, etc. :—

STEAM TABLE.

Pressure of steam by gauge.	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120	125
Temperature.....	286.9	292.5	297.8	302.7	307.4	311.8	316.	320.	323.9	327.6	331.1	334.5	337.8	341.	344.1	347.1	350.	352.8
Total heat of evaporation above 30° in heat units....	1169.460	1171.176	1172.779	1174.286	1175.710	1177.060	1178.343	1179.569	1180.741	1181.866	1182.945	1183.986	1184.992	1185.961	1186.899	1187.809	1188.695	1189.555

FEED WATER.

Temperature of feed water..	32	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
Total heat above 32° in heat units.....	0	8.06	18.1	28.1	38.1	48.1	58	68	78	88.1	98.1	108.2	118.3	128.4	138.5	148.5	158.6	168.7

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MERITS OF THE STORAGE BATTERY.

TORONTO, Jan. 23, 1891.

Editor ELECTRICAL NEWS.

MY attention having been called to an article in your January number, and believing that the writer would readily avail himself of the opportunity of being set right in reference to the all important and interesting question of the possible use of the storage battery system, for solving the question of rapid and comfortable transit, and eliminating all ideas of intentional misconception and allowing the error of judgment manifested in the article to be excusable, I nevertheless desire to set the matter before your already numerous readers in its proper aspect.

I notice the article in question refers to the storage battery as "a forlorn hope," and yet hopes against hope that the problem will be solved by an economically successful storage battery. Why, only on Thursday last in the Toronto Courts of Arbitration, Mr. Rice, the eminent City Engineer of Cleveland, on the witness stand said, in answer to counsel, that the storage battery question had been solved for street car work, and further answered in reply to questions put to him as to where the question of the commercial value of the accumulator had been solved : "Right here in your own city you have the best storage battery system on this continent, and the best for street cars or any other work I have ever seen." In reply to further questions, he said he referred to the Roberts storage battery system, of Toronto. Truly a prophet is never without honor save in his own country.

I have four distinct engagements in four different cities of the States to put my system in operation. With scarcely any effort, but simply on representations of experts, a company was formed in the States a few days ago, with a capital of $1,500,000.

Prof. Pike, a name known and relied upon all over the Dominion, after examining every known system on the continent, returned and gave an order for the School of Practical Science.

Statements regarding new storage batteries are practically worthless. In a masterly article in the *Electrical World*, the statement was made that the man who could point to a positive plate that had stood six months rough and careless work had solved the problem. Last week we forwarded to C. O. Mailloux, of New York, a positive plate that had been in constant service and subjected to continual travel for very nearly two years. Mr. Mailloux in reply expressed an opinion that established a record, and one we had need to be proud of. We are now engaged upon a plant for car work and forming a company for that distinct purpose ; that is, of utilizing the battery for car purposes.

Now, in what are the distinctive features necessary to insure a perfect battery for car work? Why exactly the features required in every purpose to which a storage battery is applied : 1st, Freedom from buckling ; 2nd, Disintregation of the paste ; 3rd, Capability of standing heavy charging and discharging. These are or have been the common difficulties to be met with in the solution of this problem. We have overcome every one of them. We have not been deterred by the "forlorn hope" ideas of anybody—no true plodder in the pathway of scientific research was ever deterred by that idea. In proof of that we give a three years guarantee.

What we have done can or may be improved upon by others, but this much is certain, that before many weeks pass a storage battery system will be in operation in or near enough to this city that will for ever settle the problem. We have quietly replaced and are replacing all the leading makes, and such is our confidence in our system that we have applied for patents in every country in the world where it is possible to obtain them.

The question has been solved in England. The Central Tramway Company, of Birmingham, are putting an extensive system into operation there ; the North Metropolitan Company are also using storage batteries. They will have to be used in all crowded cities, and certainly no where, in my opinion, would the practical solution of the question be hailed more gladly than in Toronto and Montreal. Hamilton made an offer of track, car and motor for a test on their line, which offer we respectfully refused, as we did not care to be trammelled by an agreement that rendered necessary the possible subversion of our ideas.

We have the battery, experienced engineers, and the advent of our company will at once dispel "forlorn hopes," by the recognition of the end, and object of the work of years.

A few days ago, at the invitation of the T. H. overhead system, Ald. Saunders, the mayor and a number of city gentlemen enjoyed the hospitality of the President, and after expressing their approval of everything, yet said that the storage battery would be the only permissible electric system allowed in the city.

Yours truly,

WM. ROBERTS.

THE ELECTRICAL NEWS is in receipt of an invitation to be present at the first annual dinner of the Montreal Branch, Canadian Association of Stationary Engineers. The event will be celebrated at the Richileu Hotel, Montreal, on the evening of Feb. 14th. The NEWS hopes to be represented, and to be able to present in its next issue a picture of the good time enjoyed.

The Owen Sound Electric Illuminating and Manufacturing Co. (limited), write : "We received your pioneer copy of Canadian ELECTRICAL NEWS, and are glad to welcome it as a purely Canadian publication. We trust it will receive the support it so justly merits. We enclose P. O. order in your favor for $1.50 as our subscription for 1891."

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SPARKS.

Four large dynamos are to be added to the Ottawa electric station.

The citizens of Lucknow, Ont., are about to enjoy electric street lighting.

An electric street lighting plant has lately been installed in the village of Iroquois, Ont.

The electric street lighting plant which was lately installed at New Westminster, B. C., has undergone a satisfactory test.

The capital stock of the Toronto Electric Light Co. has recently been increased from $200,000 to $300,000.

The Toronto Incandescent Electric Light Co. are placing in their station on Teraulay street, 2 new engines with a capacity of about 200 horse power.

The lady operators of the Nova Scotia Telephone Co. recently manifested their desire for the comfort of their general manager, Mr. Harris, by presenting him with an easy chair.

The people of Rat Portage complain that the telephone service has been ruined or destroyed by the placing of the electric light wires on the same poles with the telephone wires.

Mr. Cogswell, Superintendent of the Halifax Illuminating and Motor Co., was recently presented by the workmen with a smoker's outfit, accompanied by an address expressive of their esteem for him.

The new C.P.R. opera house at Vancouver, B. B. is to be lighted by 300 sixteen candle power incandescent lights, with a magnificent pendant of 50 lights in the centre. The Royal Electric Co. of Montreal are doing the work.

The Telephone Fire Alarm Co. of Halifax, N. S., will shortly apply for incorporation. The capital stock will be $50,000. The names of the promoters are: C. J. Spike, Dr. Hopkins, G. E. Falkner, H. V. McLeod and B. F. Pearson.

An Act of Parliament is being petitioned for to incorporate the Montreal Water and Power Co. to construct and operate systems of water-works, and works for the production of heat and distribution of electric light, heat and power throughout Canada.

The Ontario Telephone Co., who recently commenced business at Peterboro, Ont., appear to be meeting with fair success. They report having now connections with 243 subscribers, with more remaining to be connected. They have put up 420 poles and strung 11 miles of No. 12 galvanized iron wire and 5,600 feet of aerial cable.

Incorporation has recently been granted the Niagara Falls Electric Light and Power Co. (Ltd.), with a capital stock of $20,000. The promoters are: Jas. Bampfield, hotel keeper, Wm. Doran, manufacturer, Hiram Bender, Revenue Officer, Frank LeBlond and Richard Carter, steamboat owners, Thos. Quillian, accountant, and Andrew Greg ry Hill, barrister, all of Niagara Falls, Ont.

A charge has been laid against Mr. Crawford, City Electrician, London, Ont., by Mr. A. Alexander of Toronto, that when the city required certain electric supplies in the year 1885, Crawford received a commission from the rival firm and used undue influence to secure for the said firm the contract. Mr. Crawford submits proofs of his innocence, and the whole matter is under consideration by the City Council.

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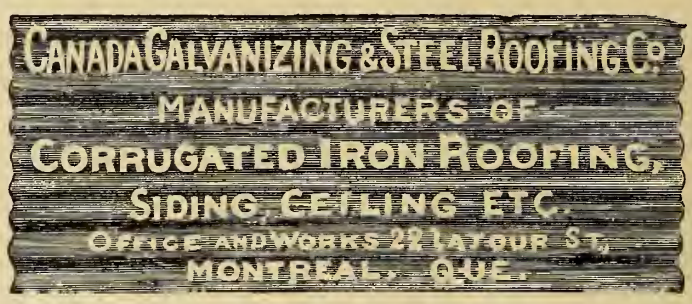
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SPARKS.

The town of Coaticook, Que., will shortly be lighted by electricity.

Mr. J. E. Saucier is fitting up an electric lighting system at Kamloops, B. C.

The Royal Electric Light Co. has just placed new engines in their station at London, Ont.

An international electrical exhibition is to take place in Frankfort-on-Main during the summer of 1891.

The city of New Westminster, B. C., expended last year on electric light works and apparatus the sum of $32,000.

The town of Milton, Ont., has arranged with the Ball Electric Light Co. for the purchase of an electric plant for street lighting.

A franchise for electric lighting has been granted a company at Prince Albert, N. W. T. The plant is being got ready for operation.

The contract for furnishing 13,000 ties for the proposed Ottawa electric street railway has been awarded to the Rathbun Co., of Deseronto.

A heavy storm of sleet caused a considerable amount of damage to the telephone, telegraph, and electric light wires in St. John, N. B., and vicinity on Jan. 18th.

A 400 horse power compound condensing engine has been constructed by the Albion Iron Works Co., of Victoria, B. C., for the Electric Tramway Co. of that city.

The Edison General Electric Co. is offering for sale its manufacturing premises at Sherbrooke, Que., in view of the intention to remove to the new works at Peterboro' in the spring.

The first electric passenger elevator to be manufactured and operated in Canada is being placed in the Sun Life Assurance Bldg. at Montreal by Messrs. Miller Bros. & Toms, of that city.

The Victoria Electric and Illuminating Co., of Victoria, B. C., has been re-organized with increased capital. A new board of directors has been appointed, with Mr. M. Hutcheson as superintendent.

Experiments are said to have proved that where electric lights have been used in place of oil lamps for lighting the compasses of vesse'ls at night, an incandescent lamp brought close to the compass caused a deflection of the needle.

It is understood to be the intention of Messrs. Patterson & Corbin, manufacturers of electric street cars at St. Catharines, to remove their works from that place, and the city of Hamilton is spoken of as likely to be their new location.

Electricity, the temperature of feed water and the strength of boilers were subjects upon which interesting discussions took place at the last regular meeting of Toronto branch No. 1 of the Canadian Association of Stationary Engineers.

On the 18th January a fire broke out in Messrs. Weir & Weir's flax mill at St. Mary's, Ont., in which is located the electric machinery for lighting the town. Considerable damage was done, but fortunately the lighting plant was saved almost without injury.

An employee of an electric light company was injured while in the performance of his duty. He was engaged in trimming lamps upon a circuit which, under the rules of the company, should have been dead at the time he was working upon it. As a matter of fact it had come in contact, at a point where the insulation was weak, with a live circuit, and had become charged. It would unquestionably have been negligent for a company to turn a current of electricity into the circuit on which he was at work without notifying him of the fact, and it was equally negligent to permit the circuit to become charged by failing to exercise proper precautions as to the crossing of wires and the insulation; and whether the company or its officers actually knew of such defect or not, the company is bound by the effect of its own neglect, and is liable in damages to a workman so injured. This decision was rendered in the case of Kraats vs. Brush Electric Light Co., in the Supreme Court of Michigan.

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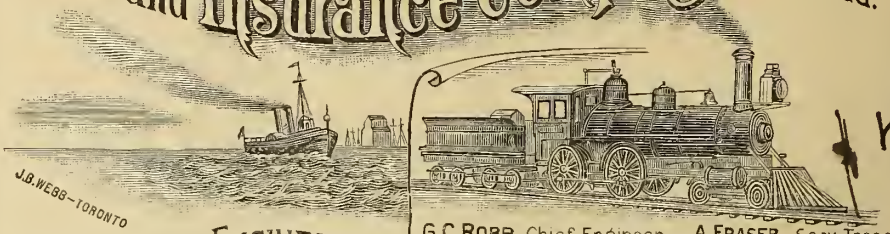
The reason why platinum answers better than any other metal for the leading-in wires of the incandescent lamp is because of its rate of expansion and contraction by heat, which is about the same as glass. Thus the vacuum in the lamp is maintained as it could be by no other metal now known.

Determined attempts are being made in Chicago to suppress the blinding smoke that is blown ashore from passing steam-craft. An experiment was made recently to demonstrate the practicability of a new invention. A small tube with a perforated top like that of a sprinkling-can, was introduced into the smoke-stack, and through this steam could be injected upon the uprushing smoke, which immediately condensed. The little tube with its jets and sprays of steam, is not a steam consumer, but there seems to be little doubt of its utility in the prevention of smoke.

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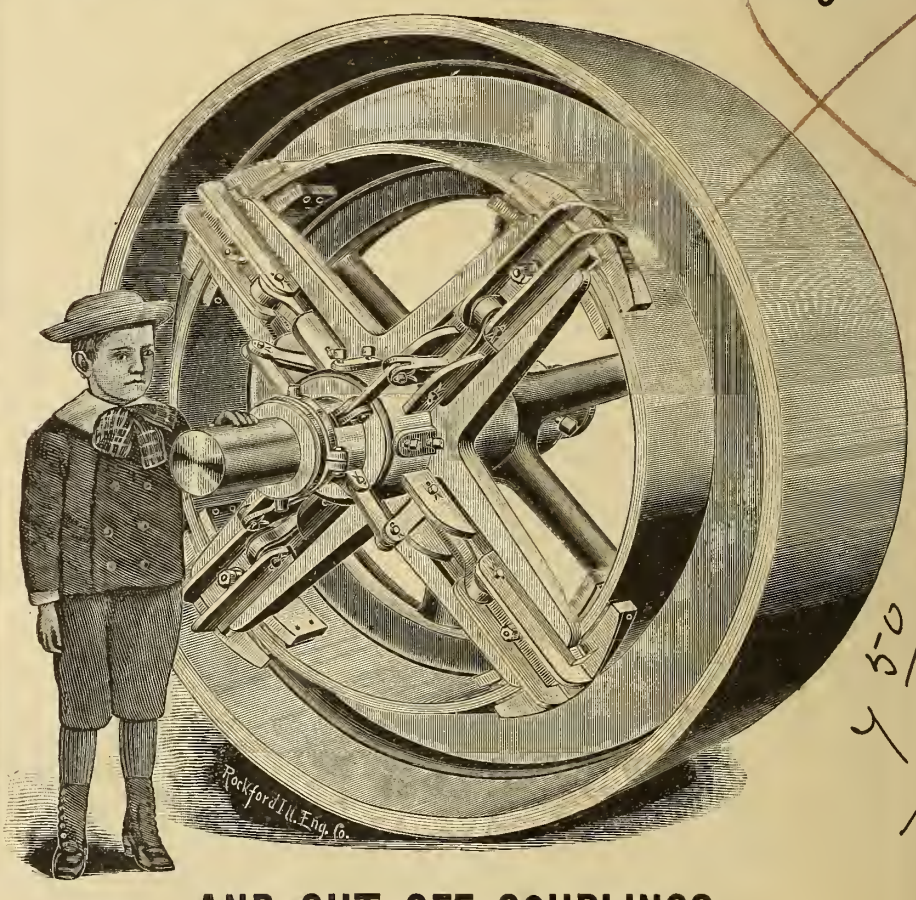
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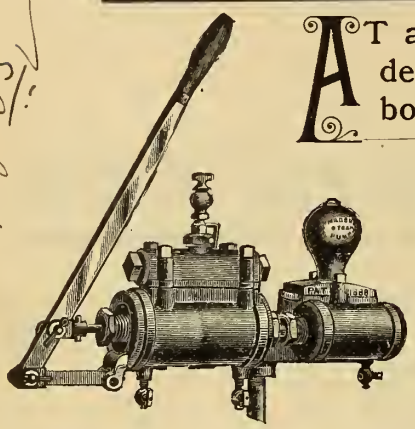
We have one of the best equipped factories in the world, and employ a large and efficient staff of electrical engineers and experts.

We are still increasing our capacity, which has more than doubled itself during the past two years, and are in better position to-day, than ever before, to handle large contracts. We are always pleased to furnish intending customers with full information and estimates.

MARSH INDEPENDENT STEAM PUMP

FOR STATIONARY, PORTABLE AND MARINE BOILERS.

OVER 2,000 MARSH PUMPS SOLD IN THE UNITED STATES DURING 1890



THIS CUT SHOWS SMALLEST SIZE MARSH PUMP, WITH HAND LEVER.

AT a recent test by Prof Cooley, of Michigan University, 48 degrees of temperature was added between condenser and boiler in passing through pump.

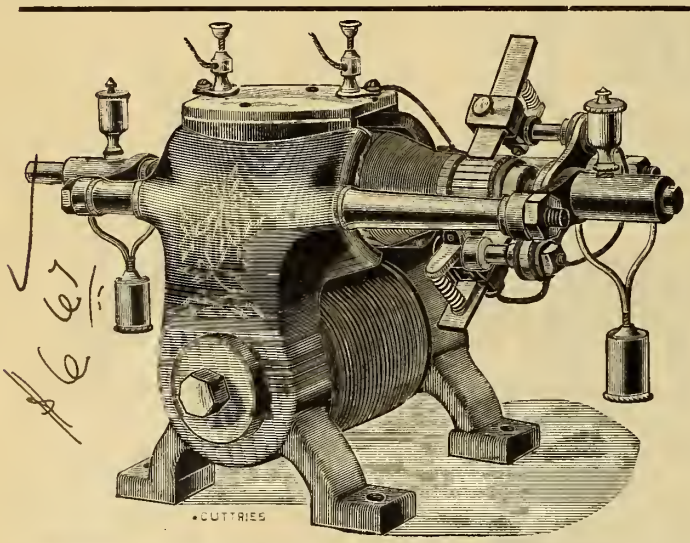
Absolute Actuation and Regulation without the use of Tappets, Levers, or other Mechanical Construction.

As the exhaust mingles with feed water and returns to boiler, there is no loss of heat, hence it is the most economical pump in use. For hot or cold water or liquids, with or without Hand Pumping Attachment, NO PUMP EVER MADE THE RECORD OR BECAME SO POPULAR AS THE "MARSH."

Patented in Canada 7th February, 1889.

MANUFACTURED ONLY BY

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DYNAMOS

For Arc and Incandescent Lighting.

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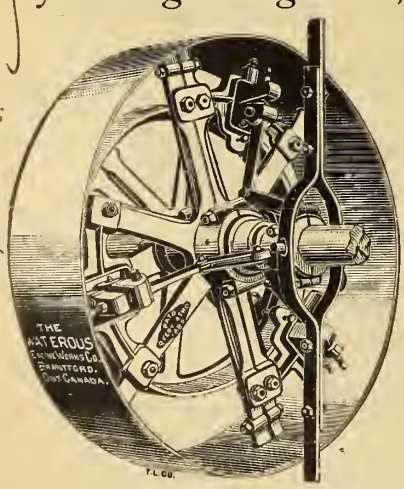
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ELECTRO PLATING MACHINES AND GENERAL ELECTRICAL APPLIANCES. SPECIAL ATTENTION TO MILL AND FACTORY LIGHTING.

WRITE FOR CIRCULARS.

DO YOU STOP YOUR MACHINE

By lifting a tightner, throwing off the heavy belt, or stopping the engine? All of these are objectionable.



We have patented a Friction Grip Pulley, —compact, simple, durable, large frictional area, ample clearance when out of engagement, powerful gripping mechanism.

We guarantee this pulley to work satisfactorily and to be thoroughly reliable.

Made split when required, and with 2, 3, 4, 6 grips for any class of work. Also a Cut-off Coupling of the same design.

Send for circulars and prices.

THE WATEROUS ENGINE WORKS CO., BRANTFORD, CANADA.

CANADIAN

ELECTRICAL NEWS

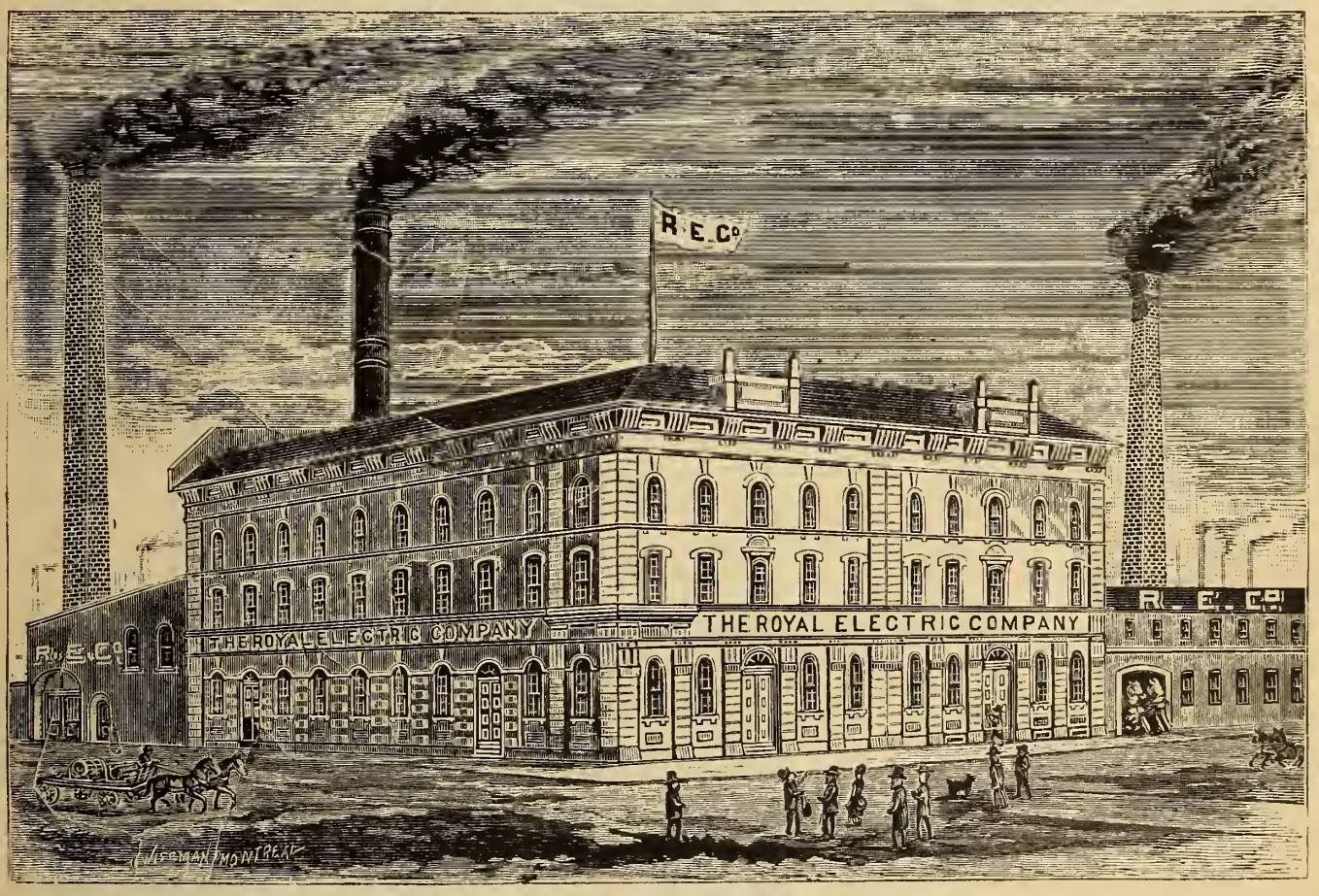
AND

STEAM ENGINEERING JOURNAL.

VOL. I. TORONTO AND MONTREAL, CANADA, MARCH, 1891. NO. 3.

ROYAL ELECTRIC COMPANY.

THE Royal Electric Company, of Montreal, cuts of whose premises, lighting station and testing room appear in this issue, was first started as the Thomson-Houston Company of Canada, in the year 1883, and was afterwards transferred to the American Illuminating Company, which was afterwards re-transferred to the Royal Electric Company, of Montreal, under whose management the largest electrical business in Canada is now being carried on.



The capital stock of the Royal Electric Company was originally $250,000, which has since been all paid up and increased to $350,000. This company manufactures the celebrated Thomson-Houston system of arc lights and the Thomson system of alternating and direct current incandescent lighting, as well as motors, generators, etc., for the transmission of power.

Their business has grown to such magnitude that their present large quarters are too small for the growing demand for goods of their manufacture.

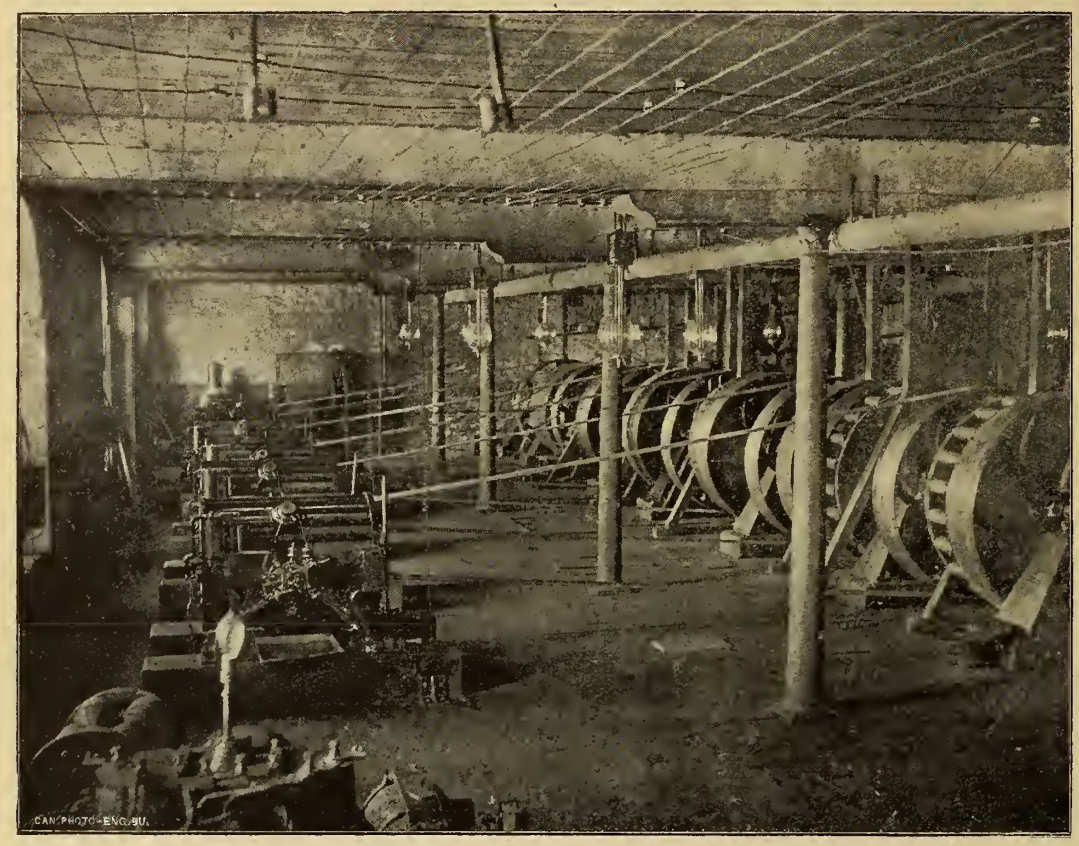
Their sales to outside companies during the fiscal year ending March, 1890, amounted to about $300,000, and for the year ending March, 1891, their sales will have amounted to something like 50 per cent. over last year.

This company confine themselves entirely to the manufacture of electrical apparatus for the trade with the exception of the city of Montreal, which city they light almost exclusively. They have at present running nightly in the streets the equivalent to 1,000 arc lamps, and have two stations for generating the electricity to supply them. The station and factory, of which we show cuts to-day, is situated in Wellington Street, near the Lachine Canal, and during 1890 they erected a large station at Hochelaga, which is one of the finest and best equipped electric light stations in America.

Their steam plant in both these stations aggregates about 2,500 horse power, and the city lighting is so arranged that in case of a conflagration at either station, the city would not suffer, as there is capacity enough at either station to fill the needs of street lighting.

The electrical machinery turned out by this company is so well known that very little is necessary for us to write on the subject. The company have manufactured and have now in operation in the different cities in Canada upwards of 6,000 arc lamps run from central stations and 1,000 run from isolated plants. Although it is now only two years since they started to manufacture incandescent machines, they have upwards of 20,000 incandescent lights run from central stations and 7,500 run from isolated plants. This makes a total of 27,500 incandescent lights, which is a very good record for two years' work. The stock of the company is held almost entirely in the cities

of Montreal, Toronto, Quebec, and a few other cities in Canada, and the company is exclusively a Canadian one. The president, the Hon. J. R. Thibaudeau, Senator, is a very efficient officer of the company, and his genial face can be seen almost any day at the head offices on Wellington Street. A great deal of the prosperity of the company is due to his untiring efforts in its behalf. The Board of Directors is composed of representative mercantile gentlemen of Montreal. Mr. W. J. Withall is the vice-president, and Messrs. Geo. R. Robertson, E. A. Small, Wm. Cassils, J. A. L. Strathy and F. L. Beique compose the board. Mr. Hagar, the general manager, has been with the company almost from the start. The other officers are: Mr. H. H. Henshaw, treasurer; Mr. David A. Starr, general agent, and Mr. Fred. Thomson, the chief electrician, who is a brother of Prof. Elihu Thomson, the inventor of the system. The lighting department is under the superintendence of Mr. D. Thomson, with Mr. F. H. Badger as electrician.



ILLUMINATING STATION, ROYAL ELECTRIC COMPANY, MONTREAL.

The company have a large staff of electrical engineers and experts who are trained and qualified to install their plants and carry out their contracts, and in some cases remain to operate the plants for the local companies who install them.

The staff of machinists and laborers number over 400, and a visit to the factory will repay anyone for his trouble; in fact to anyone interested in any way in electrical machinery, a visit there is a rare treat. The staff is courteous and obliging, and unlike many of the institutions of a similar nature in the United States and elsewhere, there is no difficulty for strangers to gain admission. This factory compares very favorably in equipment with the largest factories in the world, and is the fifth largest establishment of the kind in America.

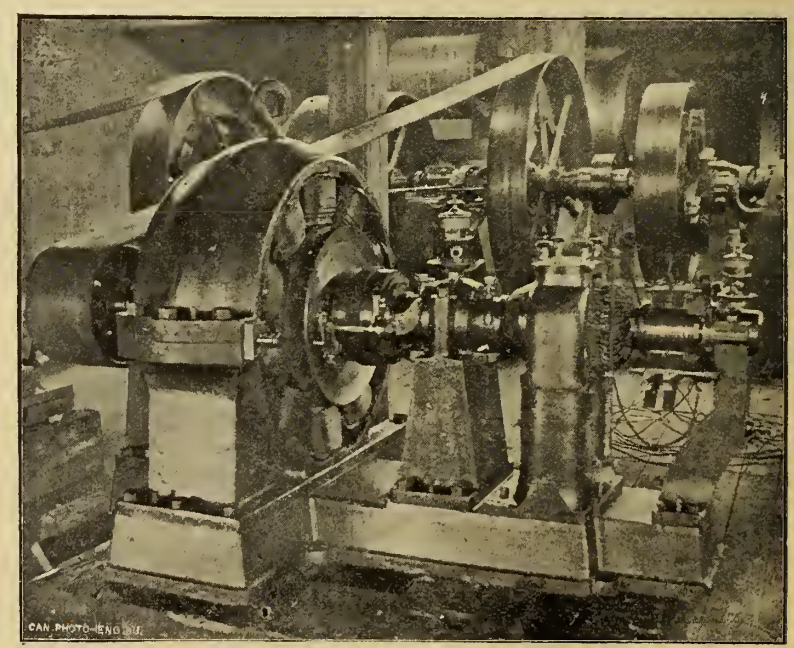
At their works can be seen all classes and sizes of dynamos, from the small fifteen light incandescent dynamo up to the monster 1,500 light alternating machine, which weighs in the vicinity of seven tons. On a recent visit to the establishment, we saw on entering the factory proper, castings for machines of all sizes waiting their turn on the large planing machines.

On ascending to the first storey we enter the tool and stock room, which is by no means the smallest feature in this establishment. Here are seen drills, dies, jigs and all manner of machinists' tools. In the lathe and drill room, which is 125 by 60 feet, the entire space is taken up by lathes of all descriptions, drills, from the light and sensitive one to the large radial, small planers, stamping presses and other appliances necessary for machine work. In a large room adjoining this are the cutters and large ovens, where armatures, transformers and kindred articles are baked. In the flat above this is a large space seventy-five by sixty feet where the brass workers and finishers are. Here we see many more lathes and other machinery. In a room adjoining this is the carpenter shop. Here are all the large patterns, wood-turning machinery, circular saws and carpenters' benches.

The lamp and transformer testing room is well worth a visit. The arc lamp rack accommodates 100 lamps, and the immense incadescent lamp racks cover the whole side of one wall. The armature winding room is another very interesting department to the visitor, all descriptions of armatures, from the smallest incandescent up to the largest arc and alternating, are wound here.

The chief electrician has his own "den" and laboratory on this flat. His shelves are replete with all the latest periodicals and books on the subject of electricity. His stock of testing instruments is one of the largest in America. The list of these expensive articles is too numerous to chronicle here.

On the fourth storey is situated the wire covering department,



TESTING ROOM, ROYAL ELECTRIC COMPANY, MONTREAL.

where there are forty different machines for covering wire of all sizes with all sorts of covering and insulation. The company have covered an immense quantity of wire within the last two years, which has been used almost entirely by themselves and in their installations. The offices are situated on the ground

flat, and the rest of the building, which covers in the vicinity of 60,000 square feet, is taken up by two large stations.

The great success which has attended the efforts of this company to supply the public with first-class electric light apparatus has been mainly due to the superiority of their system, and that they keep in view the fact that any inferior work will reflect discredit on the apparatus. Their business has grown to such an extent that they contemplate an early removal to larger and more extensive premises. We wish them every success in their undertakings, and may their efforts continue to be crowned with success.

ENGINEERS' COMPETITION.

THE publisher of the ELECTRICAL NEWS invites engineers throughout Canada to compete for the solution of the following problems:

1. What is a horse power as applied to a boiler?

2. How much is gained if feed water can be had at 120° temperature instead of 40°?

3. With water at 40° fed into the boilers, and steam taken off at 90 lbs. pressure, how much coal should be required for each thousand gallons of water used?

4. What would be the safe working pressure for a horizontal tubular boiler, 64 in. diam., 14 feet long, with 90 tubes, 3 in. diam., shell made of 60,000 lbs. steel plates ⅜ in. thick, and double rivetted in longitudinal seams?

5. Give size of furnace for soft coal for such a boiler, and size of smoke pipe, and area and height of chimney for a range of six boilers of same dimension?

6. An engine has cylinder 18 in. diam. and 18 in. stroke, and makes 240 revolutions per minute. Steam is supplied at 90 lbs. pressure in boilers, 30 feet away. What size should steam pipe be?

7. With steam cut off in above engine at ⅙ of the stroke, and discharged into a heater open to the atmosphere, what horse power can be got?

8. If a condenser be added, maintaining a vacuum of 26 in. on the gauge at the condenser, what *additional* power could be got from engine?



9. What difference to the amount of fuel per horse power per hour should there be between above engine using a heater giving water at 190° and using a condenser, maintaining a vacuum of 26 in., and supplying feed water at 100°?

10. If engine speed varied while the pressure of steam and load were constant, what should be done to remedy the defect?

11. In a high speed automatic cut-off engine, what is the effect of the weight of the reciprocating parts on the steadiness of motion?

12. The duty of the governor is said to be to regulate the speed; upon what conditions does its power to regulate depend?

13. What are the advantages of "compression" in the steam cylinder?

14. Describe the defects in the annexed diagram, and state what should be done to remedy them.

Cash prizes of $15 and $10 respectively will be paid to the competitors whose answers to the above questions shall be found by the judges to be deserving of the highest number of marks, and who shall have complied with the undermentioned conditions.

CONDITIONS OF COMPETITION.

1st. Competition is open only to subscribers to this journal actually engaged in the charge of steam boilers or engines within the Dominion of Canada.

2nd. Answers must be received at the office of the ELECTRICAL NEWS, not later than April 15th, marked "Engineers' Competition."

3rd. The answers will be judged and marked by points, in accordance with the merits of each.

4. Allowance will be made for neatness of writing, etc., as well as for correctness of answers.

5th. As a guarantee that answers are from the men intended, each competitor must send with his paper the name and address of his employer.

Messrs. Geo. C. Robb, Chief Engineer of the Boiler Inspection and Insurance Co., Toronto, and Mr. A. M. Wickens, ex-President Toronto Branch No. 1, Canadian Association of Stationary Engineers, have kindly consented to act as judges in this competition, and their decision will be final.

PUBLICATIONS.

We have been favored by Messrs. F. E. Dixon & Co., manufacturers of leather belting, Toronto, with a copy of "Dixon's Leather Belting Hand-Book," which contains a considerable amount of information of various kinds of value to users of belting.

KEEP YOUR BOILERS CLEAN.

A STEAM boiler is a vessel in which water and heat are mixed in order to make steam. Heat is produced by means of combustion of fuel of some kind in a furnace and is made to bear upon one side of the metal plate forming the boiler, while the water is on the other side. The heat passes through the metal, and entering the water, raises the temperature as observed by an ordinary thermometer. When a temperature of 212° Fahr. is reached, particles of steam are formed, and appear as small globules in the water. These steam globules are formed in some parts of the boiler long before the whole mass of water has reached 212°, and attempt to rise up through the water to the surface, but until the water is hot enough not to condense them as they rise, they cannot reach the surface and no steam is formed.

As the temperature rises within the boiler, currents are induced, the colder water going down and the hotter rising up. These currents will continue so long as steam is being made, hence in designing any steam boiler provision should always be made for the descent of colder water as well as for the ascent of hotter water and the globules of steam.

There are two practical difficulties that interfere with the steam-making powers of boilers. The first is, that in burning the fuel the boiler plates and flues become coated with dust and tarry deposits, which, being poor conductors of heat, prevent it from entering the metal as freely as it otherwise would. The careful and skillful engineer in charge of steam boilers knows this difficulty and regularly cleans out the tubes and sweeps or scrapes the dust and other deposit from every part of the heating surface of the boiler. Any one who neglects to keep the boilers under his charge clean in the tubes and heating surfaces gives plain proof either of ignorance of his business or of indolence; and an ignorant and lazy man should be anywhere else than in charge of steam boilers. The other difficulty is the formation of scale and deposit inside the boiler. It is easier to know this trouble than to find a cure for it. Boiler purgers, scale solvents, sediment preventers, have been made and patented and sold by the thousands and yet scale forms inside, even in the best regulated boilers, when certain kinds of water have to be used. Every true engineer knows that the more scale and dirt inside the boiler, the more heat goes up the chimney, and the less the steam made out of the coal burned.

The best "scale solvent" and "feed water purifier" combined, but not patented, is an honest, intelligent engineer who will regularly open up his boilers and clean them. He may or may not use purger or a "scale preventer," but he will know how to get the scale off or prevent it getting on, so as to make the most of the coal burned.

Every engineer should pride himself on the cleanliness of his boilers, both inside and outside, and in having an ash-heap with nothing in it but ashes.

Every boiler owner is not competent to judge whether or not his engineer is cleaning the boilers properly and keeping them in good condition, but let any man find unburnt coal and clinkers forming the main part of the ash-heap, and he will not, as a rule, be far astray if he concludes that it is time he had a better engineer.

PERSONAL.

Our thanks are tendered to the publishers of the *Electrical World* for a copy of the Bulletin issued by them at the National Electric Light Convention.

Two chemists are reported to be experimenting at Freeport, Pa., with the object of producing carbon points for electric lighting from natural gas. It is said that by burning the gas in a specially prepared furnace pure carbon is obtained, but as yet at a cost too great for practical purposes.

SAFETY VALVES—THEIR HISTORY, ANTECEDENTS, INVENTION AND CALCULATION.

By William Barnet le Van.

[*Continued from January Number.*]

VALVES.

The bellows was probably the first instrument of which they formed a part. No other machine equally ancient can be pointed out in which they were required. That the bellows is of antediluvian origin, there can be little doubt, for neither Tubal-Cain nor any of his pupils could have reduced and wrought iron without it.

Strabo attributes the bellows to Anacharis, who lived about 600 years B. C. Pliny (B. vii., 56), attributes it to the fabled Cyclops of Greek mythology. The prophet Jeremiah, who lived long before Anacharsis, speaks of it in connection with metallurgical operations: "The bellows are burned, the lead is consumed of the fire; the founder melted in vain." Isaiah, who lived still earlier, namely, in the eighth century, B. C., alludes to the blacksmith's bellows: "The smith that bloweth the coals in the fire." Job, nine or ten centuries before the Scythian flourished, speaks of the blast furnace as common: "They gather silver, and brass, and iron, and lead, and tin, into the midst of the furnace, to *blow the fire* upon it to melt it." Homer, as might be supposed, could not fully describe the labor of Vulcan without referring to this instrument. His account of the great mechanical work is equally descriptive of a smith and his forge of the present day.

> "Obscure in smoke, his forges flaming round,
> While bathed in sweat from fire he blew,
> And puffing loud, the roaring bellows blew.
>
> Just as the gods direct, now loud, now low,
> They raise a tempest, or they gently blow."
>
> [*Iliad*, xviii. 435, 545. *Pope.*

The most important improvement on the primitive bellows, or bag, was the admission of air by a *separate* opening—a contrivance that led to the invention of the *valve*, one of the most essential elements of steam or water, as well as pneumatic, machinery. The first approach to the ordinary valve was a device that is still common in the bellows of some African tribes. A bag formed of the skin of a goat, has a reed attached to it to convey the blast to the fire, and the part which covered the neck of the animal is left open for the admission of air. This part is *gathered up* in the hand when the bag is compressed, and opened when it is distended. (Fwbank's Hydraulics, 235).

The principle of the *valve* has always been in use for a variety of purposes. Doors are *valves*, and were so named by the ancients. Those of the private apartments of Juno were contrived by Vulcan to close of themselves. Thus, Homer sings:

> "Touched with a secret key, the doors unfold,
> Self-closed behind her shuts the valve of gold."
>
> [*Iliad*, xiv.

It is probable that all valves were originally in the form of doors; that is, mere flaps or clacks moving on a hinge, and either lying horizontally, like a trap-door; inclined, like some of our cellar doors; opening vertically, as an ordinary door; or suspended by hinges, from the upper edge; and sometimes they consisted of two leaves like folding doors. Examples of all these are still common. Isis was represented by the ancient Egyptians with "the key of the sluices of the Nile" in her hand, the instrument by which the doors or valves, like the locks in our canals were opened and closed.

The most ancient musical wind instruments known in the Eastern world are provided with valves, as the primitive bagpipes, and the Chinese variation of this instrument, which Toreen describes as consisting of "a hemisphere to which thirteen or fourteen pipes are applied and catching the air blown into it by valves." The pastorial flute of Pan, from its expressing thirty-two parts, he supposes to have been of a similar construction, (Osbeck's Voyage, ii. 248). Valves were, of course, employed in the organs of Jubal, as well as in the bellows belonging to his celebrated brother, and other antediluvian blacksmiths. The ninth problem of the *Spiritalia* relates to valves. Conical metallic valves were used by Ctesibius, of Alexandria, one of the most eminent mathematicians and mechanicians of antiquity, in the construction of *clepsydræ*. (Instruments used by the Greeks and Romans, for measuring time by the gradual discharge of water from a large vessel through a minute perforation in the bottom).

The spindle valve, or such as have a long shank to prevent their rising too high, and guiding them when descending, is said to be of French origin.

EARLY SAFETY VALVES.

The liability of alembics and stills to burst, led the old chemists to apply plugs to the openings in these vessels, that the vapor might raise or dry them out and escape ere the pressure exceeded the strength of the vessels. In old works on distilling, conical plugs, or valves, are shown as fitted into cavities on the top of boilers, and, in some cases, were loaded. In the *Maison Rustique de Maistres Charles Estienne et Jean Liebault, Docteurs en Medecine* (Paris, 1574), are figures of two *close* boilers, in which the distilling vessels were heated; one formed a water, and the other a vapor, bath. On the top of each is a conical valve, opening upwards. These served both to let out the superfluous steam and to introduce water. Glauber, who contributed several valuable additions to the mechanical department of chemistry, has figured and described in his "Treatise on Philosophical Furnaces," the modes by which he prevented glass retorts or stills from being burst by the vapor. A long stopple, or conical valve, was fitted to the neck of each, being ground air-tight to its seat, and loaded with a "cap of lead," so that, when the steam became "high," it slightly raised the valve, and a portion escaped. The valve then closed again of itself, "being pressed down with the leaden cap, and so stopped close." English translation, London, 1651, page 306). The safety valve on Newcomen's first engine was of this description.

The above safety valve is now known as a "positive safety valve," the valve as now made being flat, conical, or spherical, thus exposing a greatly increased area when opened. This is a meritorious feature, as the experiments of Baldwin, Richardson, Adams, and numerous safery-valve makers have proven. In these, the weight is either placed directly above or below the valve, and acts without the aid of levers.

In the same work, Glauber describes the most philosophical of all safety valves—namely, a column of mercury enclosed in a bent tube, which communicates with the boiler or still, somewhat like the modern mercurial guage. He also describes that beautiful modification of it known among chemists as the "water lute," or "quicksilver lute," which is made as follows: Around the mouth or neck of a vessel, a deep cavity is formed and partly filled with water or mercury, as the case may be. A cylindrical vessel, opened at the top and closed at the bottom, form the cover; it is inverted, the open end being placed in the cavity and dipping as far into the liquid as the internal pressure may require. In "The Art of Distillation; or, A Treatise of the Choicest Spagyrical Experiments," etc., by John French, Doctor of Physic, London, 1651, the author describes the same devices for preventing the explosion of vessels as those mentioned by Glauber. Speaking of the action of such safety valves, he observes: "Upon the top of a stopple [valve] there may be fastened some lead, that if the spirit be too strong, it will only heave up the stopple and let it fall down again."

LEVER SAFETY VALVE.

The common lever safety valve was invented by a Frenchman, Solomon Decaus, and was improved by Denis Papin. Through the influence of the celebrated Boyle, whom he assisted in his experiments with the air pump, Papin was elected a Fellow of the British Royal Society in December, 1680. He was an active and useful member, and contributed several interesting papers to the society's transactions. In 1861 he invented a method of softening bones, with a view to extract nourishing food from them—namely, by submitting them to the action of steam at high temperatures (pressure), in close vessels named *digesters*.

Papin's first digesters were liable to be rent asunder by the high pressure of steam accummulating in them when in place on the fire with their orifices stopped. They are shown in detail in Poliniere's "Experience de Physique," second edition, Paris, 1718. Each consisted of a short but very thick tube, of bell metal, about a foot in length and five inches in diameter, with one end closed. The open end had a collar cast on it, to which the cap or cover was secured by clamps and a screw. The cover and end of the tube were ground together, so as to fit air-tight, like a valve to its seat. A few bones and a little water were put in, and the cover screwed down; the vessel was then

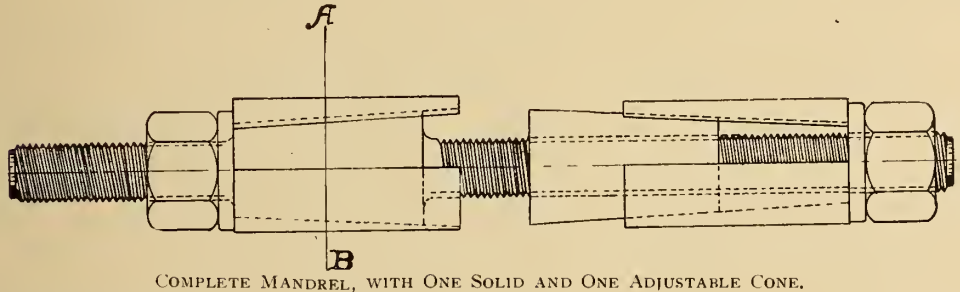
laid in a horizontal position on a bed of charcoal in a long iron grate. The almost unavoidable rupture of these vessels, led Papin to the invention of the common lever safety valve, which he first applied to them, and afterwards to machines for raising water by steam.

(To be Continued.)

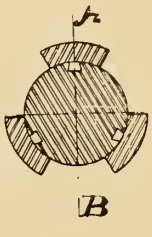
DUBRULE'S EXPANDING MANDREL.

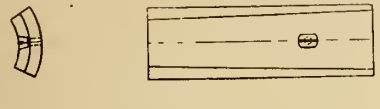
THE accompanying sketch illustrates some improvements in an expanding mandrel, which were patented in Canada Oct. 6th, 1890, by J. D. O. Dubrule. The patent has also been granted in the United States.

The drawing shows a double ended mandrel with one solid and one adjustable cone. Each cone is of the same diameter, and intended to be used on a long sleeve, bushing, or any hole that might be cored in the centre. They are also made single ended, viz., with one solid core. This mandrel overcomes the necessity of hammering the ends and burring up the centres, for by screwing up the nuts it forces the wedges up the cone, thus causing them to expand, and tightening the work on as securely as desired without injury to the mandrel. To loosen off the work, it is only necessary to unscrew the nut, and draw off the work, which will never jam sufficient to require heavy hammering.

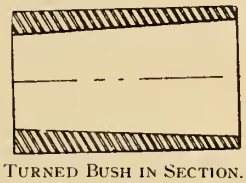


COMPLETE MANDREL, WITH ONE SOLID AND ONE ADJUSTABLE CONE.

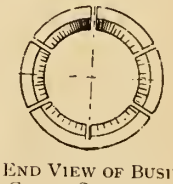




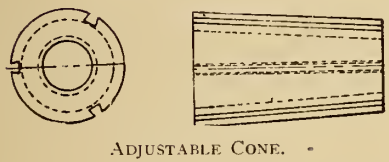
WEDGE.



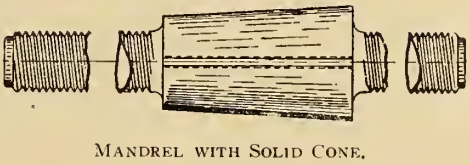
TURNED BUSH IN SECTION.



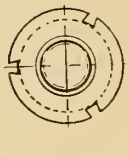
END VIEW OF BUSH, CUT IN SEGMENTS.



ADJUSTABLE CONE.



MANDREL WITH SOLID CONE.



The wedges are held in place on the mandrel by a pin fitted to a dovetail slot, cut the whole length of the cone, with a pin driven in at one end to keep the wedges from falling off, while the nut serves the same purpose at the other end. Thus there is no danger of any of the parts being lost. The wedges are segments of a steel bushing turned inside to fit the cone and turned parallel outside. The three wedges are cut from the same bush, therefore are perfectly true with each other.

The mandrel has been thoroughly tested and found to turn out perfect work, with a great saving of time. These mandrels are made to any specified sizes. The cones can be made any desired length, and tapered to take a larger or smaller range of holes, can also be made any length over all, to suit the machine over which they are to be used. Any further particulars may be obtained by applying to J. D. O. Dubrule, 206 Champlain Street, Montreal.

According to *Le Genie Civil*, a French machine tool builder, M. Burot, of Angouleme, is turning out paper pulleys for power transmission, based on the principle of the paper car wheel. The pulleys have metal hubs and arms, on which the soft paper is melted and then compressed. After drying the paper pulley is treated in a bath of linseed oil and resin, to give it greater resistance against the influence of moisture. The pulleys are said to be very light and of low price, and to have given excellent results in practice.

WANTS TO BE PUT ON THE LIST.

MR. Wm. A. Sweet, of Hamilton, Ont., writes: "I hereby tender you my thanks for having sent me the two first numbers of the ELECTRICAL NEWS, and wish your journal the greatest prosperity. I have found some useful articles in it, and you may mark me as another of your subscribers."

CANADA FIRST.

MR. A. Marshall, in forwarding his subscription to the ELECTRICAL NEWS, writes: "I am very well pleased with your paper, and think it will take well in Hamilton. I am sure that by lowering your price you will receive more subscribers. I will do all that I can to uphold our Canadian paper, which gives us home news. I am pleased to see that you are affording the opportunity to engineers to show how much they know about engineering. I wish you every success."

RUBBER BELTING RULES.

Q. What are the rules for estimating horse power, thickness, width, and speed of three-ply rubber belts say 7-32 of an inch thick, the lacing being single leather?

A. 1. The cross section in square inches needed is equal to 155.46 times the horse power, divided by the speed in feet per minute.

2. The horse power is equal to the cross section in square inches, times the velocity in feet per minute, divided by 156.46.

3. The speed in feet per minute is equal to 156.46 times the horse power, divided by the cross section in square inches.

4. The width is got by dividing the cross section by thickness.

5. The thickness is got by dividing the cross section by the width.

Examples under the following rules are herewith given so as to show more clearly their simplicity and the method of using them:

Q. How fast would a ten inch rubber belt 7-32 inch thick have to travel to carry 100 horse power, if it wrapped 135 degrees on a cast iron pulley and was fastened with single leather lacing?

A. $156.46 \times 100 \div 70\text{-}32 = 15646. \times 16\text{-}35 = 7152$ feet. (Impracticable.)

Q. What is the horse power of a ten inch three-ply rubber belt, 7-38 inch thick, running 3,000 feet per minute on a cast iron pulley; the arc of contact being 135 degrees and the fastenings single leather?

A. $70\text{-}32 \times 3{,}000 \div 156.46 = 6562.5 \div 156.46 = 41.94$ horse power.

Q. What cross section of rubber belt would be required to drive 100 horse power at 3,000 feet per minute, with 135 degrees contact on a cast iron pulley, the fastenings being single leather?

A. $155.46 \times 100 = 3000 = 5.182$ sq. inches.—*Power and Transmission.*

HAMILTON, Ont., Feb. 18th, 1891.

Editor ELECTRICAL NEWS.

DEAR SIR,—Seeing by your paper that efforts are being made to establish a Canadian Electric Light Association, I beg to state that you can count on me as being an active supporter of any such movement, and as being ready to assist in any way that lies in my power.

I remain, yours very truly,

W. J. CLARKE.

KIND WORDS FROM BRANTFORD.

BRANTFORD, Feb. 16th, 1891.

Editor ELECTRICAL NEWS.

SIR,—I am in receipt of first two issues of the ELECTRICAL NEWS and I must say it is interesting and instructive. The dynamo is fast finding its way into our factories, and every engineer interested in his calling should connect himself with a source from which he can obtain the necessary knowledge to qualify him to take charge of electrical machinery in connection with steam plant.

Wishing the NEWS success, and trusting it will receive the support it so justly deserves,

Yours truly, ARTHUR AMES.

TORONTO, Feb. 16th, 1891.

Editor ELECTRICAL NEWS.

DEAR SIR,—I beg to call your attention to question 7 in "Enquirer's Competition." The question reads: "With steam cut off at ⅛ inch of stroke." Should it not be one-sixth (⅙) of stroke?

Also in the first number of your paper, in the article on "Care and Management of Dynamo Electric Machinery," it reads: "If it (commutator) should get rough from the electric spark, it is necessary to smooth it by pressing a block of wood with fine emery cloth covered against it." Now, as emery is a conductor, if any of it should get between the segments of the commutator it would cause trouble by short circuiting. The best thing to use for this purpose is No. oo glass or sand paper, as it will do the work well if used once or twice a week, and being a non-conductor, will cause no trouble. I am of the opinion that emery might get someone into a hole.

I was glad to see you talk "business" to the storage battery man. Now, then, if he has such eternal faith in his accumulators, let him come out with them and take up your offer. Will he? Yours truly,

SAFETY.

[Our correspondent has rightly surmised that the insertion of the word "inch" between the words "one-sixth" and "stroke" was an error.—ED. E. NEWS.]

MERITS OF STORAGE BATTERIES.

MONTREAL, Feb. 5th, 1891.

Editor ELECTRICAL NEWS.

DEAR SIR,—Noting your remarks *re* storage batteries, and Mr. Roberts' reply thereto, perhaps I may be allowed to ask a few further questions:

1st. Has Mr. Roberts reduced the weight of his cells under those of other manufacturers in any way? Judging from what I have seen of it, in comparison with others, it looks heavier on the average. Is this weight not a serious drawback to the general adoption of any system of storage battery traction?

2nd. Mr. R. states his plates do not buckle? Is this an experimentally proved fact, as I note his plates have very thin centres and much heavier edges.

3rd. Is it not so that owing to the peculiar style of plate adopted by him, that through use there will be insufficient contact between the paste and the metal grid?

I admit my experience is limited in practice, having only handled a few E. P. S., and other cells, but have made considerable study of different types. I do not wish to advertise any maker in particular, but have found in my experience that, in so far as storage batteries go, the Julien, if not in the lead, are certainly not far in the rear.

To *guarantee* any storage cell unless the care of same be entrusted to one of the firm's own experts, seems to me to be risking considerable, as it is well known that storage cells need more than ordinary care in their manipulation. Storage batteries as they are to-day will require to undergo great modifications before becoming a thoroughly useful and economical article, although I admit they are a convenient source of power in many ways.

Mr. R. has modified things a little perhaps, and changed the form, whether for better or worse remains to be proven, but the fact remains that he has made no great radical change in them from what they are and have been for some time past.

Yours very truly,

"ACCUMULATOR."

MERITS OF THE STORAGE BATTERY.

HAMILTON, Ont., Feb. 27th, 1890.

Editor ELECTRICAL NEWS.

DEAR SIR,—A letter over the signature of Wm. Roberts calls for an explanation on our part, otherwise we might be considered dangerous to have any communication with. We do not lay claim to that magnetic or even electric power to run or even overthrow a mind that has such confidence in its ability to supersede all other systems, and with one stroke throw in the background all other investigators.

When in another place, in the letter referred to, the assertion is made that statements regarding new storage batteries are worthless, we would ask: How long has the one in question been in actual use? Will the writer of that epistle state where and when and under whose care the plate spoken of has been in constant use and travel for two years?

We are not speaking disparagingly of the storage battery in question, or any other. Our motto is "Live and let live," but when Mr. Roberts assumes to be the originator of storage batteries, and states that what he has done can or may be improved upon by others, let us ask the question: Did he not in the construction of his battery try to improve on what had been solved long ago?

The facts of the case in regard to the offer of car, track and motor for a test in Hamilton, was a mutual agreement between our company and the Roberts Storage Battery Company, our company to furnish motor and their's the batteries, and together to share the expense of the other equipment of the car. We had the motor ready and were prepared to carry out our part of the agreement. As to why it was not carried out, you have the statement of Mr. Roberts. We have ample testimony and evidence that our part of the contract would have been successful. The other parties to the agreement, according to their letter, will demonstrate to you very soon their ability to carry out their part, which we sincerely trust will be successful.

Trusting we have not encroached on too much of your valuable space, as we have no desire for controversy,

We are, yours truly,

KAY ELECTRIC WORKS.

ELECTRIC LIGHT INSPECTION.

WINNIPEG, Feb. 11th, 1891.

Editor ELECTRICAL NEWS.

SIR,—I cannot agree with your editorial article on the inspection of electric light. I consider it just as necessary for the consumer who agrees to pay a certain price for a 16 c. p. light to be satisfied that he gets what he pays for, as it is for the consumer who buys a pound of sugar to be able to know that he is getting a pound of sugar.

You say "the owner offers to a storekeeper or a business man his electric light and asks for it a price commensurate to its size or the hours used, so much per light per month, and nobody is compelled to take it." That is true. But the canvasser gets the consumer to sign a contract to take the light for a year, and agrees to supply him with 15, 24 or 32 c. p. lights, as the case may be, at a stated price; but the question is, does the consumer get what he pays for? I know that very frequently he does not. Very often he only gets a 10 c. p. light when he pays for a 16. The greatest electrical experts state that in the course of their experiments they find that the light given by nominal 16 c. p. lamps varies from 8 c. p. to 16 c. p. But how can the consumer prove that his lamps are not 16 c. p.? Again, if he has to pay by the meter, the meter is set to figure one hour for one hour's burning of a so-called 16 c. p. lamp, but there is no certainty that he has been given a 16 c. p. light; in fact, it may be only 10 c. p. light, yet the meter will register one hour's burning of that 16 c. p. Then, how is a consumer to know that those

chemical deposit meters register and and are computed correctly? I know one instance where the consumer refused to pay, and he kept account of the lights and number of hours used, and the company accepted half of the bill they had rendered.

What is wanted is an inspector to see that so called 16 c. p. lamps actually give 16 c. p. light, and also to test meters and prove that they register the actual number of hours that a 16 c. p. light burns correctly. That is what is done with gas consumers. The inspector sees that 16 c. p. gas is supplied, and tests the gas meters to ascertain that the amount used is correctly registered. I consider that any electrician who opposes such an inspection is the worst opponent of his business, as thereby he would lead the public to infer that it was only by fraud and deception that it could compete against gas.

The far better plan is to force those companies who now palm off 10 c. p. lights for 16 c. p. to give an actual 16 c. p. light, and compete fairly against those who supply honest light either in gas or electricity.

Yours, etc.,

WM. BATHGATE,

Man.-Director Manitoba Electric and Gas Light Co.

QUERIES AND ANSWERS.

Editor ELECTRICAL NEWS.

SIR,—Please tell me where I may obtain works treating on the management of electric machines, lamps and devices. Your paper helps me considerably, but I wish something simple, which a person with common school education can understand. Would also like to get a book describing use of electric measuring instruments. Wishing success to your enterprise, I am,

Yours sincerely,

A DYNAMO TENDER.

[Our correspondent may obtain catalogues of such books as he requires, together with prices, by addressing "The Electrician" Publishing Company, 1, 2 and 3 Salisbury Court, Fleet St., London, E. C.; the W. J. Johnston Company, *Times* Building, New York City, or H. E. Hafferkorn, Milwaukee, Wis.

A DIFFICULT PROBLEM.

QUEBEC, Feb., 1891.

Editor ELECTRICAL NEWS.

DEAR SIR,—Encouraged by your kindly invitation to propound questions, the answers to which may be of scientific interest, and reminded by the locomotive boiler explosion, an engraving of which appears in the last number of the *Scientific American*, that I am still without an answer to a question I propounded at the time in relation to a similar occurrence in Quebec some years ago, I now beg to renew the query.

From what height must a portion of boiler plate (one quarter inch thick, some fifteen feet in area, and therefore weighing about 150 lbs.), torn from an exploded stationary steam boiler and launched into the air, have fallen to have been found by me standing upright in a log of white pine timber twenty-four inches square, into which it had penetrated to a depth of fourteen inches, almost exactly at right angles to the grain of the log.

The base of the parabola described by the missile did not exceed 100 feet. The ragged piece of plate had been blown out almost to a plane by the force of the explosion, and must have descended in an almost vertical direction, as that in which it would meet with the least resistance from the retarding atmosphere, or in a plane parallel to the falling leg of the parabola, whatever its position may have have been in the ascending branch of the course.

If it be considered that a good man with all his might could hardly drive the sharp edge of an axe into a stick of timber, across the grain, to more than half an inch, it will be admitted that the blunt-edged piece of plate alluded to must have descended from an immense height, thus to imbed itself to such a depth as fourteen inches in a log of two feet in breadth.

This occurrence took place at Archer's steam mills at Sillery Cove, some five miles from the city, killing the engineer in charge ; and it was on the occasion of my appearing before the coroner's jury that I visited the premises immediately after the accident.

C. BAILLAIRGE,

City Engineer, Quebec.

[The reply to the above enquiry will be found in our editorial pages.—ED. ELECTRICAL NEWS.]

POSSIBILITIES IN ENGINE ECONOMY.

SPEAKING of economy in railway management, the *Railway Master Mechanic* says that very careful and long-conducted investigation into railroad accounts have shown to the officials of at least one railway system, that the most important single item wherein saving may be effected is to be found in the coal bill. If the same investigation could be made into the accounts of the average stationary steam power plant, the same conclusion would doubtless be reached, and for the same reason, because the item of fuel is the largest item in the expense account of the power plant. Economy in manufacturing processes in all lines of manufacture is carefully studied and the utilization of waste products, the odds and ends of raw material, is looked after sharply, but it is not every manufacturer or owner of a power plant that looks after the economy of the engine and boiler rooms. In fact, except in scattering individual instances it may be questioned if the possibility of economy in this direction is much thought of after the first selection of the plant. If there is any thought of economizing in this direction it generally takes the shape of cutting down wages paid to engineers and firemen, on the principle that the amount of coal and supplies is a fixed thing, no matter who is in charge. It is, however, gratifying to note that in some quarters there is a growing appreciation of the economy of employing competent men at good wages. It will generally be found in such cases that the higher wages paid carry with them a holding of the engineer responsible in a large measure for the economical working of the plant. Engineers are therefore interested in studying the possibilities of economy in the plants under their charge, and if they take hold of the subject in earnest they will find the study an interesting one.

In considering this subject, if the engineer will make it a home question he will find it to branch into two directions. The first question that naturally arises is whether the plant as it is at present, can, by more careful management, be run with less fuel, less supplies, less stoppages, and fewer breakdowns and repairs. The engineer must be more than ordinarily careful, if he does not find where, by closer watching and more careful study of his plant, he can improve its operation. It may be in the firing, it may be in the adjustment of the engine valves, it may be in the lubricators, or in any one of the minor details of the plant. When, and only when, he is sure that he has done all that he can do with the plant as it is, should he consider the second branch of the question, and ask what can be added, what changes should be made, and what should be thrown out and replaced by new. There are doubtless thousands of plants in which worn and leaky boilers and wasteful engines could be replaced at a steady profit to the owner, but until the engineer has made a study of the plant, and can back up his requests by strong arguments, he cannot hope to have much attention.

In considering what is possible in the way of economy in any plant the engine must have some standard of comparison. If he is running an ordinary tubular boiler he should know that such boilers when properly set and fired have evaporated eight, nine or possibly more pounds of water per pound of coal. If he finds that he is only evaporating five or six, he has before him the problem of how to make the boiler do eight or more. The boiler may be full of scale, the setting may not be right for the fuel, the chimney or stack may be too small, but so long as he is not doing as well as he knows can be done he has a fruitful subject for study and experiment. So if he is running an engine which takes 35 pounds of water per inch horse-power per hour, and, other engines of same kind have done the same work with 30 pounds, he should know why, and better the record if in his power. It is not necessary for him to waste time in speculating on what point of perfection the steam plant of the future may reach. His individual plant is the one that requires his attention, and its possioilities in economy his careful study. There are two extremes to be considered : first, the certain amount of power that must be delivered ; second, the coal pile. All between is intermediate, and every attention to detail that will reduce waste and increase efficiency will, with the same power delivered, lessen the drain on the coal pile. Leaky boilers, unprotected or leaky steam pipes, too tightly packed stuffing boxes, bearings poorly oiled or too snugly fitted, poor firing, dirty boilers, all these cost fuel and fuel costs money. The possibilities of economy in these directions are a most proper subject of study on the part of the engineer who has an ambition to rank high in his calling.

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EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

A CONTEMPTIBLE practice resorted to by some journals that lay claim to respectability is to print the original articles of contemporaries without giving proper credit. The *Western Electrician* of Chicago, in a recent issue, publishes the editorial from this journal on the subject of a Canadian Electrical Association, with the introduction "A Canadian exchange says." Our contemporary is evidently more deeply impressed with the advertising value of its columns than with a sense of what constitutes just treatment of others.

FOR the information of those who feel an interest in the success of the NEWS, we desire to state that the results thus far achieved are entirely satisfactory. The number of subscribers received during the last month is gratifyingly large, and betokens a list of healthy proportions in the near future. It is a pleasure to note the careful interest with which the paper is read, and the commencement already made by subscribers in the direction of using its columns for the expression of their opinions. With co-operation on the part of our friends we hope to make each successive number increasingly valuable.

IF the storage battery as now constructed ever comes into general use, there is one point that must not be lost sight of, and that is the risk of explosion. Do not start, gentle reader, but calmly look into the thing. There is no mysterious inherent danger in the storage cell *per se*, but just a plain everyday blow-up. The reason is this. During the charging process a considerable amount of gas is liberated, and if the cells are located in a confined space, or even a small room, if there are cells enough, the contained air soon becomes charged with the requisite quantity of gas to make a very pretty demonstration on the introduction of the necessary spark or match to inaugurate the proceedings. Moral: Ventilate the apartment in which you keep your storage batteries while in process of charging.

WE are glad to see that our friends of the Edison Company have decided to abandon their "fly on the wheel" policy of condemning everything electrical that had an E.M.F. of over 220 volts, and have come squarely out with a 50 light arc machine which must necessarily employ an electromotive force of at least two thousand. Verily, the world moves. A year or two ago and Thomas A. would have held up his hand in holy horror at the mention of such a sacrilege, but we fully expect in the near future to hear that he has exploited a full-fledged alternator, "with all that the name implies." The philanthropist Brown will now have to take a seat in the rear, or else hunt for fresh fields and pastures new. Time is a great avenger, though we see nothing derogatory to the company in all this. They simply are enterprising enough to recognize the advancement of public opinion in the matter, and put themselves in a position to supply the popular demand.

WE congratulate Mr. Albert J. Corriveau that, as the result of persistent effort on his part, the city of Montreal has been selected for the summer convention of the National Electric Light Association. The Association will no doubt feel like congratulating itself after the convention is over upon the wisdom of its choice. Montreal is not only a city of much interest in itself, but it is so situated as to afford visitors easy access to many outside points of interest. There is no reason to doubt that every needful preparation will be made to render the visit of the association both pleasant and profitable. The result of the gathering upon electric interests in Canada cannot be other than highly beneficial. We quite agree with Mr. Corriveau in the opinion that the event should stimulate our people to organize a purely Canadian association. Every Canadian interested in electricity should endeavor to attend this convention, observe the lines upon which the National Association is working to advance electrical interests in the United States, and seek to be of assistance in applying the knowledge thus gained to the advantage of the industry in Canada.

MOST people can look after their enemies themselves, but require to be saved from their friends. We are moved to make this remark by the action of a company engaged in an electrical manufacturing enterprise in this province, who have recently offered to furnish a small municipality with eight or ten electric lights for eleven cents per night each. They know well that it is impossible to make any profit at a price like this, and must therefore depend on unloading the plant on some unsuspecting party by means of representations that, to say the least of it, economize very much in the matter of truth. The harm done does not stop here, for this false price is bandied about and quoted by municipal busybodies and others as a genuine thing, and strikes at the very root of the industry which it should be the province of these manufacturers to foster. The field is large enough and the business sufficiently progressive to provide ample scope for legitimate enterprise without the necessity of resorting to a cut-throat policy which must only end in disaster to those engaged in it. Legitimate competition on fair and honest lines is all right, and is usually considered to be the life of trade, but when it involves the necessity of some unsuspecting purchaser being made the victim, it is time to draw the line. All who are interested in electrical enterprise and development should unite in condemning this injudicious depreciation of values, which it is of the most vital interest to themselves should be maintained.

WE print in this issue a letter from the manager of a combined electric light and gas company, taking exception somewhat to our remarks on electric light inspection. We have pleasure in giving space to the communication, though we are afraid our correspondent is looking at the matter more especially from the standpoint of the gas department. If a consumer foolishly signs a contract for a year to take his pork in the original package without examination, it is only what is accomplished every day by oily-tongued and unscrupulous salesmen. If men are to be protected from their own foolishness it would require a government inspector at every man's door to keep watch and ward. If *light* were a monopoly, and could only be obtained from one source, a paternal government might properly interfere to regulate its distribution, but as in this enlightened age there are various sources from which it may be obtained, it may safely be left to take care of itself. The ordinary laws of business competition will regulate both its price and quality. The doctrine of "the survival of the fittest" will apply in this as in all things else, and the instance our correspondent mentions of the customer keeping track of his light and the company being compelled to accept only what was right, completely bears out the position we took. The customer probably told the company in effect that "this business is too thin, and if you don't come down off your horse, I will go back to the gas people," and

down they came accordingly. Precisely what we said. The government inspector would have been completely *de trop* in this transaction, and if any short-sighted people have signed a contract for a year, why, the year will soon have expired, and then our Winnipeg friend may rest assured that the best and cheapest light will undoubtedly take front rank without any assistance from Her Most Gracious Majesty or any of her minions.

THE drum armature will have to go. Of course all manufacturers make armatures that "never burn out"—at least their's do not, it is only the "other fellow's." Users of dynamos must therefore come to the conclusion that it is the "other fellow's" armatures that they have got, for the burning out process comes around pretty regular. This much being admitted, that will be the most successful machine that in case of accident admits of easy repair. The superposed coils of the Siemens wound or drum armature make it an expensive affair. It is usually the inner coil, or the one next the core, that gets into trouble, either by making contact with the core itself or by reason of undue heating by not having an equal chance with the outer coils to radiate its self-generated heat. When the inner coil goes it necessitates the unwinding of the whole armature to get at the trouble, and the expense of complete re-winding. The ring or Gramme armature, on the contrary, admits of any particular coil being unwound and replaced without disturbing the rest, and is for that reason an advance on its competitor. But the Gramme ring armature that is constructed with a sectional core, admitting of a coil being taken out and a new one inserted entire, has claims to superiority that will enforce recognition. The drum armature, like the memorable deacon's one-horse shay, may be constructed according to the nicest calculations, and the durability of its different components figured down fine, but the fact remains that when it does go it goes all over, and the unfortunate manipulator thereof is left with a wreck as total as that which overtook the deacon's masterpiece. The owners of electric plants of every description will agree with us that the makers of fireproof armatures had better go out and take in their signs. There is no reason why a dynamo should be exempt from the influence of wear and tear, or should be any less liable to accident or decay than any other creation of man's hand. This being admitted, the armature that is repaired at the least expenditure of time and money, when in the ordinary course of human events it has become necessary to do so, will be the one to attain the greatest degree of popularity with the electricians.

THERE have been in use in the large cities of the United States for some time various systems of automatic fire-alarm for stores, warehouses, etc. Some of these are now being brought forward in this country, and it is usual for the insurance companies to make some inducement to their clients when they are employed. When the alarm gong is located in the room or residence of an employee or some person connected with the concern, they would no doubt serve a useful purpose. It has been the practice in some cases to connect the building by means of a wire with the nearest fire station, but such a method cannot be too strongly deprecated. To do this it is necessary to sneak a wire over house tops or by some similarly devious route. This wire is liable to be a continual trouble. On the one hand, too much reliance may be placed on its being in order, and necessary vigilance in other directions relaxed, when through some cause it is incapable of transmitting a signal, and on the other, a false signal may be sent in, causing the brigade a run for nothing. This would not be of much moment except for the fact that some day a genuine alarm might be sent in, and on account of the previous cries of "wolf" when there was no wolf, a fatal amount of credulity might be attached to the warning. A preferable plan would be to place a continuous ringing gong on the outside of the house itself to call the attention of all and sundry to the fact that something was wrong within. The action of the sun on a flat roof has frequently been the means of sending in an alarm of fire when the thermostats have been closely adjusted ; and if they are not closely adjusted, a fire might make considerable headway before notice was given. The proposal to connect these thermostats with the nearest fire alarm box to spring the alarm from the box, cannot be too strongly condemned. The less complication there is about a city fire alarm system the better, and the more likely it is to remain in working order when actually needed. The automatic fire alarm is good in its place, and might frequently be the means of saving a large amount of property, but keep it separate from the municipal system by all means.

A CORRESPONDENT writes that after a boiler explosion he found a piece of boiler plate one quarter of an inch thick and weighing about 150 pounds, which had fallen almost perpendicularly on a log of square timber twenty-four inches thick, with such force that the plate had imbedded itself into the log for fourteen inches, and that across the grain. He asks from what height must it have fallen in order to have such force stored in it as to cut a channel across the grain twenty-four inches wide and fourteen inches deep with a cutting edge one-quarter inch thick. It would be almost impossible to calculate the force necessary to make such a cut without making some experiments in order to form a sound basis for the calculation. However, some idea of the force may be formed in another way. We may assume that when the boiler exploded there was not less than eighty lbs. pressure shewn on the steam gauge. The sudden rupture of the boiler would permit its contents to escape into the atmosphere. Experiments in the flow of steam have shown that steam at eighty lbs. pressure will flow into the atmosphere through a safety valve at a rate equal to a velocity of 1,456 feet per second. This being the case, it is not unlikely that the piece of boiler plate started on its upward flight with an initial velocity not less than 1,000 feet per second. Leaving out of account the resistance of the air, a body projected vertically into the air at such a velocity would go up three miles before it stopped and began to fall. If we allow one-third of the force to be absorbed by the friction of the air, it would ascend two miles and then begin to fall. Again deducting the one-third for friction of the air while descending, the plate would strike the log with a velocity of nearly 550 feet per second. This velocity of a body of 150 pounds weight would be approximately represented by a pressure of 700,000 pounds on the surface of the log. The surface struck by the plate would be twenty-four inches by one-quarter inch, making six square inches, and the force of the blow would therefore have been about 116,600 lbs. per square inch, and we need not wonder that the log was cut to a depth of fourteen inches before all the energy was expended.

WITH the expiration of the year eighteen hundred and ninety closes the first decade of the existence of the electric lighting industry. Its marvellous growth has been unexampled in the history of invention and the adaptation of Nature's forces to the requirements of the higher civilization of the human race. While it has taken centuries for the evolution and development of its ally, the steam engine, from the crude and cumbrous machinery of Newcomen and Lavery, through the intermediate researches and improvements of Watt and Stephenson to the magnificent results attained by the triple and quadruple expansion machines of to-day, but ten short years have elapsed since the electric light commenced to become a factor in the commercial world. Now many millions of capital and some of the most brilliant intellects of the age, together with thousands of intelligent workers, are engaged in the industry. And it appears to us that the threshold has but scarcely been crossed, and as the vista of unlimited possibilities opens up more widely the nearer it is approached, it requires not a prophet's skill to foretell that the termination of another decade will have in store for us further developments of the industry of which until recently we have scarcely dared to dream. The magnificent possibilities that may arise from the theorizing of Hertz on the line of the identification of electricity with the etheric waves of light, the adoption of electricity in the manipulation of metals throughout the whole range of the mechanic arts, from the smelting furnace to the delicate finish of the most costly and elaborate piece of jewelry, after the manner of melting and uniting similar and dissimilar metallic substances by the process originated and elaborated by Professor Thomson, of Lynn ; and the adaptation of electricity as a transmitting agent for the power required in the operation of railroad trains with greater speed and safety, are all within measureable distance of the production of grander results than have even yet been attained. Ten years ago the

pioneer manipulator of the electric light machine was to the uninitiated looked on as being molded of superior clay; now the mysterious apparatus is handled by the mechanic in almost every mill and machine shop in the land, and while the more abstruse problems of the science may still be confined to the "upper tendom" of its votaries, they are very rapidly becoming the property of the rank and file of the army of workers, and it will not be long before every intelligent mechanic will understand the principles that underlie the manifestation of the force he will be frequently called upon to handle. Magnificent as have been the realizations of the past, we are on the threshold of still greater developments to-day. And we say to all who are interested in electrical enterprises—keep abreast of the best that is doing, and be prepared to sieze the golden opportunity that will come with the further developments of this marvellous science.

FIRST ANNUAL DINNER OF MONTREAL BRANCH C.A.S.E.

THIS event, which had been looked forward to with pleasant anticipation by Montreal engineers, took place at the Hotel Riendeau, in that city, on the evening of February 14th. The members and guests numbered fifty-three, with the genial president of the association, Mr. Geo. Hunt, presiding. Letters of regret were read from A. E. Edkins and A. M. Wickens, president and past president respectively of the Toronto branch of the association, his worship the Mayor, Prof. McLeod, Mr. Champagne, city boiler inspector.

On the tables, in addition to the choice viands which formed the subjects for discussion during the earlier part of the evening, were displayed, as appropriate emblems of the occasion, models of engines, indicators, injectors, steam gauges, whistles, etc.

On the removal of the cloth, Mr. T. Regan briefly reviewed the progress of the association since its organization in 1885. The membership had largely increased, and it was gratifying to see present some of the original charter members. The principal object for which the association exists, namely, to improve the efficiency of its members, was dwelt upon.

Mr. Thos. Clark responded on behalf of "The Brotherhood of Locomotive Engineers," and in doing so said that under the rules of that organization none but competent men could obtain certificates.

Mr. Walter Laurie responded for "Mechanical and Steam Engineering," pointing out many of the improvements made during the past half century.

"The Manufacturing Interests" were ably represented by Mr. Hugh Vallance.

Mr. E. C. Robinson, of the Royal Electric Co., and Mr. J. Mortimer, of the ELECTRICAL NEWS, had a few words to say in response to the toast of "Electrical Engineering."

The President, in proposing the toast "The License and Inspection Law," said it was the duty of every engineer to see that his boilers were regularly inspected and repaired. Had there existed an inspection act for the province similar to the measure in operation in the city, the recent explosion at Quebec, with its terrible consequences, would probably not have occurred.

Mr. Samuel Fisher responded to the toast.

"The Canadian Association of Stationary Engineers," "Our Guests," and "The Press" were all duly honored.

At intervals during the evening a pleasant variation in the program was introduced by Messrs. Donnen, Buckle and Hunt singing some capital songs.

The evening throughout was one of solid enjoyment, intermingled with not a little profit. An excellent commencement has been made in the direction of an annual reunion which will doubtless be found among the bright spots of the future.

The Kerr Engine Company has succeeded the firm of Kerr Bros., engine builders, at Walkerville, Ont.

MR. GEORGE HUNT.

THE subject of this sketch was born in the town of Whitehaven, in the North of Scotland, some thirty-two years ago. He was brought to Canada when a young lad and put to work in a machine shop, but working in a machine shop was not congenial to his tastes. He decided to adopt the profession of stationary engineering, so went into the boiler room as fireman.

That his experience, mechanical skill and reliability have been appreciated, is evidenced by the fact that he is now chief engineer of the Royal Electric Light Co.'s plant, which is the largest steam plant in the City of Montreal. His position is no sinecure—he is a very busy man.

He has a sturdy, methodical thoroughness about him, an unflinching devotion to duty which can be seen as he sits in his cosy office receiving the reports from his subordinates and attending to the duties which devolve upon the chief of a great plant. He is married, is revered by his loving wife and family, honored and looked up to by his brother engineers and members of Montreal No. 1 Canadian Association Stationary Engineers, of which he has the honor to be President. He is rugged, honest and true in every fibre, a magnificent specimen of old British oak.

Mr. Hunt loves his steam engine indicator, and to see him at his best is when he is indicating an engine, explaining to his brother engineers the lines on the indicator card—showing those who are not so well posted the admission line, the steam line, the cut-off, the expansion curve, etc. He well deserves to have prospered, being an honor to his profession and the country of his adoption.



MR. GEORGE HUNT.

TORONTO BRANCH NO. 1, C.A.S.E.

At the last regular meeting of the above Association, after a long discussion, the following resolutions were unanimously adopted:

Resolved, That the city of Toronto absolutely requires more pumping capacity at once, and any further delay in providing it will be a dangerous and unwarranted risk.

Resolved, That Lake Ontario is the natural reservoir for the city of Toronto, and with suitable modern pumping machinery will be the cheapest and best place from which to procure water for all purposes.

The principal points brought out were the probability of accidents to the present pumping plant during the summer months, thus causing a water famine; also that the rapidity with which the city is growing demands that some measure should be taken at once to procure the necessary machinery to insure a bountiful supply of *pure* water.

The following resolution was also adopted:

Resolved, That in view of the many boiler explosions that have occurred so recently in the Dominion of Canada, with their attendant loss of life and property, the Governments at Ottawa and Toronto be memorialized to pass some measure under which boilers may be operated with safety.

A joint stock company is being incorporated at Kamloops, B.C., to operate the electric light plant recently established there.

Messrs D. W. Clark & Sons are putting a new seventy horse power steel boiler in their electric light works at Carleton, N.B.

In describing a visit to Logelbach, the home of Mr. Hirn, a writer in *Industries* refers to an arrangement for superheating steam in an engine which has been in use for forty years. This plan of Mr. Hirn's was one of the first put to the test and practically applied, is still always in use, and is considered to give a greater economy of feed-water than the steam jacket. The amount of superheating is about 140° Fah. The superheating apparatus consists of a series of pipes, and is invisible, as it is placed toward the end of the boiler, where the hot gases play constantly over its surface. This method involves no additional expenditure of fuel or labor. The mere fact that the superheating arrangement has been in constant operation for so many years, without more detriment to the valves, gear, etc., than is incidental to any engine when at work, proves that the system is of real practical advantage, and deserves more attention than it has hitherto received.

SPARKS.

The Royal Electric Company have this week shipped a complete outfit, consisting of a 300 light alternating dynamo, steam engine, boiler and complete electric equipment, to Moose Jaw, N.W.T.

The large new building of Messrs. Morgan & Campany, of Montreal, which is to be a second "Wannamakers," is now being equipped by the Royal Electric Company with the necessary boilers, dynamos, etc.

The Montreal Water Power Company have been granted incorporation for the purpose of constructing and operating water and electric light systems throughout the province. The capital stock is $2,000,000, and the names of the directorate are: Messrs. Thos. J. Drummond, Raymond Prefontaine, R. White, Geo. E. Drummond and James T. McCall, Montreal; John F. Moffett, Watertown, N.Y.; H. C. Hodgkins and Charles T. Moffett, Syracuse; Emily C. A. Woltman, J. V. Clark and George T. Keith, New York.

The Standard Electric Company, of Ottawa, which has recently been formed, propose going very extensively into incandescent electric lighting and power. This company was organized last week with the Hon. E. H. Bronson, M.P.P., president; Mr. Pattee, vice-president; Mr. C. Berkely Powell, managing director; Mr. J. Bronson, sec.-treasurer; Mr. C. H. Mackintosh, M.P., and Mr. Perley, directors. The capital stock is $500,000. The company have closed a contract with the Royal Electric Company, of Montreal, for all their dynamos, generators, motors, etc. They propose installing from 12,000 to 15,000 incandescent lights and about 500 horse power during the coming year. This is one of the largest contracts ever made by one company in Canada.

THE STREET CAR HORSE AND THE ELECTRIC CAR.

I'm the happiest horse in town to-night!
I go with flying feet!
For I have seen the gladdest sight
Way up in north Yonge street.
And what it means I know full well,
And when I've said my say,
Down where I dwell at the Horse-Hotel,
There will never a horse say "neigh."

I know I'm right; and now for the sight
At the C. P. crossing I saw—
A street car with a brilliant light,
But never a horse to draw.
It rolled along, now fast, now slow,
Steady and straight on the track;
But what makes it go, I'm sure I don't know—
There was no horse, front or back.

It looked like the other cars in town
Yet there is something strange, I feel;
To-night I saw, on looking down,
The lightning under the wheel.
I heard things out of the common rule—
Strange words I never knew;
Yet I'm not a fool, I've been to school
To Mister Bartholomew.

I'm simply a slave; but my freedom is won;
The thought thrills through my soul!
If without a horse one car can run
Why cannot two hundred roll?
I am tied to the track, one day from my back
The harness will drop at my feet,
And I shall be free, no work then for me
On the track of the stony street.

With a sniff and a snort and a toss of my head
And a flirt of my flying feet,
I will take my bones from the pavement stones
To the country soft and sweet!
And day and night I shall owe my flight,
The joys I there shall meet,
And my freedom bright, to the strange, strange sight,
That I saw in north Yonge-street.

—Toronto *World*.

BRITISH COLUMBIA MARINE ENGINEERS' ASSOCIATION.

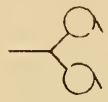
MR. W. P. LINDLEY, Secretary of the British Columbia Marine Engineers' Association, writes, enclosing subscription on behalf of that organization, a copy of the constitution and by-laws under which its proceedings are conducted, and a copy of the first annual report. From the latter we learn that since the association was organized a year ago, its growth has been satisfactory beyond the brightest anticipations of its promoters. Starting with a few engineers employed on the steamers sailing from the port of Victoria, B.C., which is the association's headquarters, it has added member after member, until at present the membership numbers upwards of 90. The association is endeavouring to demonstrate to the public that membership in the association is a guarantee of ability and good character. This is working on right lines, and leaves little room to doubt that the association has a long and useful career awaiting it. The members are comfortably housed at No. 76 Yates Street, with a snug balance in the treasury. The officers for the current year are: James A. McArthur, president; William Steele, 1st vice-president; Alex. M. Fraser, 2nd vice-president; P. M. Butler, treasurer, and W. P. Lindley, secretary. We are sure the older organizations in the East will join the NEWS in wishing this young and energetic association continued success.

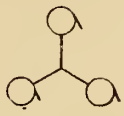
CALCULATING SIZES OF WIRES.†

PLANS AND SYMBOLS.—When the wire contractor has decided upon the general system to be followed in running wires and in locating switches and cut-outs, he should make a general plan. This plan should show the location of each incandescent outlet with the number of lamps, and give in each case the distance from the dynamo or main distributing point. The following symbols are generally used in such a plan:


Sixteen candle power lamp without key.


Sixteen candle power lamp with key.


Two-arm bracket with key-holders.


Three-light chandelier with key-holder.

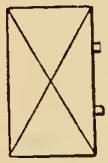

Ten candle power lamp.



Thirty-two candle power lamp.


Wall switch.


Safety plug.


Dynamo.

DROP OF POTENTIAL AND LOSS OF ENERGY.—If a current of constant strength is passing through a circuit of uniform resistance, the potential will fall uniformly.

A B, Fig. 1, represents a wire of uniform thickness, marked off into 10 equal parts. If the potential or e.m.f. between *A* and

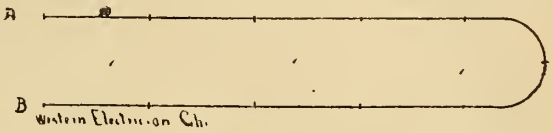


FIG. 1.—FALL OF POTENTIAL ALONG A CIRCUIT.

B measures 100 volts, the e.m.f. measured at the terminals of each of the equal divisions will be $\frac{100}{10} = 10$ volts.

If the circuit offers uneven resistances to the passage of the current the potential will fall unevenly; and it will be found it will fall most rapidly through that part of the circuit which offers the greatest resistance. In fact, the fall of potential in any part of a circuit is in every case proportional to the resistance of that part of the circuit.

A C and *B D*, Fig. 2, are conductors of 10 ohms' resistance each. *C D* is an incandescent filament of 180 ohms resistance hot.*

The total resistance of the circuit would be $10+180+10=200$ ohms, or in other words, 20 ohms or 10 per cent. is represented in the conductor and 90 per cent. in the lamp.

Assuming the e.m.f. between *A* and *B* to be 100 volts, 10 per cent. or 10 volts will be lost in overcoming the resistance of the conductors and 90 per cent. or 90 volts will be expended in the lamps. The loss in the wire of course is not desired, but is a necessary evil, hence the resistance of the wire conductors might be termed the wasteful resistance, and the resistance offered by the lamp as the useful resistance.

* NOTE.—In these calculations the resistance of an incandescent lamp is assumed as that of the carbon filament when hot. Carbon filaments when cold are of much higher resistance than when hot.

† From "Incandescent Wiring Hand-Book."

The percentage of the total potential which is wasted in the conductors is called the "Drop of Potential," or briefly the "drop."

As the loss of energy for the same current strength in any particular case is proportional to the "drop," it is correct to speak of the "percentage of energy" lost in the conductors. In

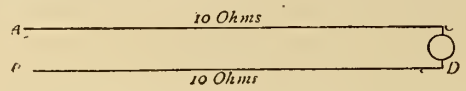


Fig. 2.—Distribution of Resistances and Potentials.

the last example we may therefore say either that there is a 10 per cent. drop, or that 10 per cent. of the energy is lost in the conductors.

Electrical energy may be found by multiplying the current in amperes by the e. m. f. in volts. According to Ohm's law $C = \frac{E}{R}$ or using the figures of the last example, $C = \frac{100}{200} = \frac{1}{2}$ ampere. If we now multiply ½ by the e. m. f. we get the energy in watts: ½ × 90 = 45 watts, the energy expended in the lamp: ½ × 10 = 5 watts, the energy lost in the conductors. We see that 5 watts form 10 per cent. of the total energy of 50 watts, and that therefore 10 per cent. of the energy is lost in the conductors.

It may now be readily understood how the sizes of wires for certain percentages of loss may be determined. Let us take 100 lamps of 180 ohms' resistance each. The total resistance of these lamps, joined in multiple, is $\frac{180}{100}$, or 1.8 ohms.

The problem is to lose 10 per cent. of energy in the conductors; in Fig. 3, 1.8 ohms represent then 90 per cent. of the *total* resistance, which includes lamps and conductors. The total resistance of lamps + conductors is therefore $= \frac{1.8 \times 100}{90} = 2$ ohms and the resistance of the conductors $= \frac{2}{10}$ or .2 ohms. Suppose the distance from dynamo to lamps 500 feet, the whole length of the circuit is 1,000 feet. The problem is now to determine the size of a copper wire whose resistance for 1,000 feet of length

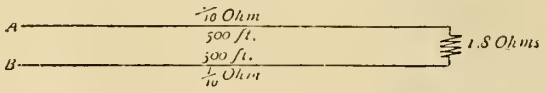


Fig. 3.—Distribution of Resistances and Potentials.

is .2 ohm. We may use Table II. In column No. 11 the resistances of copper wire per 1,000 feet are given. The nearest number to .2 in that column is found to be .205, which corresponds to No. 3 B. & S. wire. This is the required size of the wire.

Practical Rules for Determining Proper Sizes of Wires.—Although a *general* explanation of the principles underlying the calculation of the sizes of wire was given in the previous chapter, it is necessary to have *practical* rules for this purpose—rules which will enable us to determine the size of wire without the aid of a table.

The resistance of a unit wire, *i. e.*, a pure copper wire 1 foot long and 1 circular mil in cross-section, measured at 75° Fahrenheit, is 10.79 ohms.

Suppose in Fig. 4 *a* represents the unit wire; *b* a wire of the same cross-section (one circular mil) but 2 feet long. If the resistance of *a* is 10.79 ohms, it is obvious that the resistance of

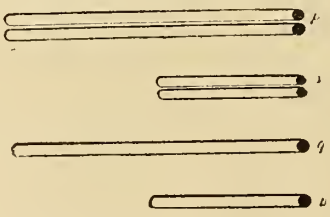


Fig. 4.—Resistances of Wires.

b will be twice that of *a*. Let us assume farther that *c* is a cable 1 foot long and of two circular mils cross-section. Its resistance naturally will be ½ that of *a*. Suppose *d* is a cable 2 feet long and of two circular mils cross-section, its resistance will then be equal to *a*. This demonstration leads us to the first rule:

Rule 1. The resistance of a copper wire is equal to its length in feet multiplied by 10.79, and divided by its cross-section in circular mils.

We may write this rule in symbols thus:

$$R = \frac{10.79 \times L}{d_2}$$

in which R is the resistance in ohms, L the length of wire in feet, and d^2 the square of the diameter in mils.

We can also write the formula thus: $d^2 = \frac{10.79 \times L}{R}$ from which we may deduce:

Rule 2. The cross-section of a copper wire in circular mils is found by multiplying 10.79 by its length in feet and dividing the result by its resistance in ohms.

Example.—Find the cross-section of a wire 1,000 feet long and of a resistance of 100 ohms.

$$d^2 = \frac{10.79 \times 1000}{100} = 107.9 \text{ circular mils.}$$

In incandescent wiring, however, the resistance of this wire is a certain percentage of the total resistance of conductors and lamps.

The total resistance of a certain number of lamps joined in multiple arc is found by:

Rule 3. The total resistance of lamps in multiple arc is found by dividing the resistance of one lamp when hot by the number of lamps.

We may also write this as a formula thus:

$$\text{Total } R = \frac{r \text{ of lamp hot}}{\text{number of lamps}}.$$

It may be mentioned that the resistance of a lamp when hot may be found by dividing the e.m.f. by the current. (Compare Ohm's law).

Example.—Find resistance of a lamp hot of 110 volts e. m. f. and .55 amperes of current:

$$r = \frac{110 \times 100}{55} = 200 \text{ ohms.}$$

Example.—Find the total resistance of 50 110 volt lamps connected in multiple. $R = \frac{200}{50} = 4$ ohms.

It will be remembered that the joint resistance of the lamps is only a part of the total resistance of the circuit, which includes wires and lamps. (See Fig. 3).

Rule 4. The resistance of the conductor is found by multiplying the total resistance of the lamps by the percentage to be lost, and by dividing the product by 100 minus the percentage of loss.

Written as a formula, this rule becomes:

$$R = \frac{r \times \%}{100 - \%}$$

If we combine rules 3 and 4 we obtain:

$$R = \frac{r \text{ hot}}{N} \times \frac{\%}{100 - \%}, \text{ or in words:}$$

Rule 5. The resistance of the conductor is found by dividing the resistance of one lamp hot by the number of lamps (N) joined in multiple arc, and multiplying the quotient by the percentage of loss, divided by 100, minus the percentage.

Example.—Find the resistance of a conductor for 50 lamps, each of 200 ohms' resistance hot, with 10% loss.

$$R = \frac{200}{50} \times \frac{10}{100 - 10} = 4 \times \frac{10}{90} = \frac{40}{90} = \frac{4}{9} \text{ or .44 ohm.}$$

It is not sufficient, however, to find the resistance of the copper conductor. It is also necessary to determine its cross-section in circular mils.

It is stated under Rule 1 that $d^2 = \frac{10.79 \times L}{R}$. The explanation of the symbols is repeated: 10.79 ohms represent the resistance of a unit wire, L is the length of a circuit which is twice the distance, R is the resistance of conductors.

If for L in the formula we substitute twice the distance, 2 D, we have $d^2 = \frac{10.79 \times 2D}{R}$ and if we now insert for R the value as given in Rule 5 and multiply 2 by 10.79, we find that

$$d^2 = \frac{21.58 \times D}{\frac{r \text{ hot}}{N} \times \frac{\%}{(100 - \%)}}$$

We can simplify this and obtain the general important wiring rule:

Rule VI. $d^2 = \frac{21.58 \times D \times N}{r \text{ hot}} + \frac{(100 - \%)}{\%}$ in which d^2 = circular mils; D = distance in feet; the distance is ½ the full length of the circuit; N = number of lamps; r = resistance of one lamp hot; % = desired percentage of loss in conductor given as a whole number and not as decimal fraction.

Example: 150 lamps are to be run 400 feet with 5 per cent.

loss. The voltage of the lamp is 110 volts, and the current per lamp is ½ ampere.

Demonstration: We must first find the resistance hot of one lamp: resistance hot $= \frac{\text{volts}}{\text{amperes}} = \frac{110}{\frac{1}{2}} = 220$ ohms.

Working by rule VI we obtain

$$d^2 = \frac{21.58 \times 400 \times 150}{220} \times \frac{(100-5)}{5}$$

$$d^2 = \frac{21.58 \times 400 \times 150}{220} \times \frac{95}{5} = 111{,}823 \text{ circular mils.}$$

By referring to Table I we find that this wire is a little larger than No. 0 B. & S. gauge.

Rule 6 will hold good for all lamps and for every percentage of loss. The cross-section of the wire is found in circular mils, and no table is necessary.

Rule 7. Where lamps or groups of lamps are placed at different distances from the dynamo, determine first the proper wire for each lamp or group of lamps if placed on independent circuits starting from the dynamo, then combine all wires running in the same direction.*

Fig. 5 shows three groups, 1, 2 and 3, of 50 lamps each. D is the dynamo, and + and − its positive and negative binding posts. The first group is 100 feet from the dynamo, the second 250 feet, and the third group 350 feet. We figure on lamps of 220 ohms resistance hot and 5 per cent. loss. Take the most distant group first. Proceeding by Rule 6 we find

$$d^2 = \frac{21.58 \times D \times N}{220} \times \frac{100-5}{5}$$

As we desired to figure on the same kind of lamps and same percentage of loss we may simplify our calculations by first figuring out the constant part of our formula or "a constant" and subsequently multiplying $D \times N \times$ constant.

$$K \text{ (constant)} = \frac{21.58}{220} \times \frac{100-5}{5} = 1.86$$

$d^2 = D \times N \times 1.86$. $d^2 = 350 \times 50 \times 1.86 = 32{,}550$ circular mils for Group 3. Taking Group 2 we find:

$d^2 = 250 \times 50 \times 1.86 = 23{,}250$ circular mils.

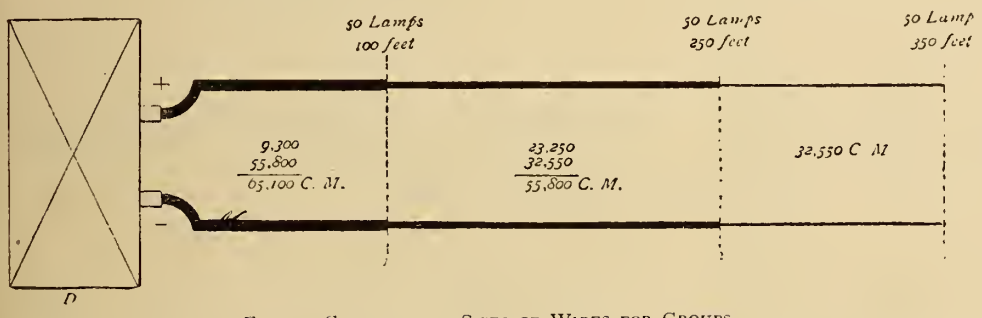


Fig. 5.—Calculating Sizes of Wires for Groups.

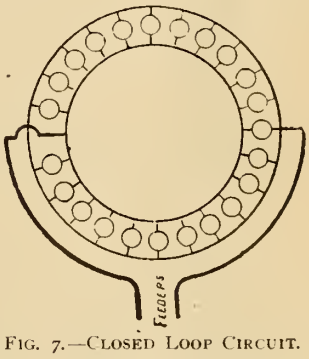


Fig. 7.—Closed Loop Circuit.

Adding to this total 32,550 we have a wire of 55,800 circular mils to be used for Section 2.

Proceeding in the same way with Group 1 we find:

$d^2 = 100 \times 50 \times 1.86 = 9{,}300$ circular mils, which added to the total in the last case gives 65,100 circular mils.

From these data we conclude that we must use a wire of 65,100 circular mils between the dynamo and Group 1; a wire of 55,800 circular mils between Group 1 and Group 2, and a wire of 32,550 circular mils between Group 2 and Group 3.

Rule 8. First calculate the sizes of mains and feeders; then determine the sizes of branches. Not more than 5 per cent. loss must be allowed between the main distributing point and lamp outlets.

In the closet system, for instance, 3 per cent. loss may be

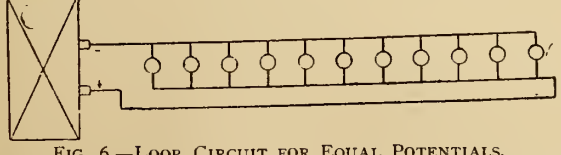


Fig. 6.—Loop Circuit for Equal Potentials.

allowed from the dynamo or main distributing point to the closets and 2 per cent. from the closets to the lamp outlets.

*By groups of lamps is meant a number of lamps comparatively near each other, as for instance, lamps in a room of a building or on a chandelier, or, in station lighting the lamps in one store. Up to the first group, the mains must be of sufficient size to carry all the lamps or groups of lamps in circuit. Beyond the first lamp or group the mains may diminish as the number of lamps or groups diminish.

The percentage of loss in the wires should be made as small as possible, for two reasons: In the first place, a large drop in the wires involves considerable waste of energy, and secondly the system will not admit of automatic regulation of the pressure. Complaints are often made that an incandescent dynamo does not regulate very closely, i.e., when a number of lamps are thrown on or off, the remainder of the lamps become dimmer or brighter as the case may be. It is obvious that, no matter how efficient the dynamo or the transformer may be, a considerable loss in the wires will interfere with the maintenance of even pressure throughout an entire system.

Suppose we have figured mains for 100 lights on a basis of 20 per cent. loss; lamps to be of the 112 volt class. In this case the dynamo must run at 140 volts, with 100 lamps in the circuit; 20 per cent. of 140 = 28 volts, which is the drop in the wires. If 50 lamps are switched out, and the potential of 140 volts at the dynamo remains unchanged, the voltage at the lamps will increase 50 per cent. of 28 volts, or to 112 + 14 = 126 volts.

This condition of course would be fatal to the life of the lamps. Again it may happen that while on one branch all the lamps are running, on another, only a small fraction of the total number of lamps is switched on. The lamps on one circuit would thus burn at nominal pressure or candle power, while on another circuit they would be far above the nominal candle power. If only a small percentage of loss has been allowed in the wires, this condition cannot ensue, as the maximum difference in the potentials of the different circuits must necessarily be within the percentage of loss allowed in the wires.

The foregoing considerations lead us to:

Rule 9. Calculations should be so made that substantially the same potential (within two or three volts), may be maintained at every point in the circuit, no matter how many or how few lamps be burning at different points.

It can easily be seen that that would be an ideal system, where each lamp was provided with a separate circuit direct to the dynamo. No matter how many lamps were switched on or off, the percentage of loss in the other circuits would not be altered. Of course such a system is impracticable. The next best thing is the subdivision of the system of wiring into as many independent circuits as possible. The adoption of this plan will result in many advantages, for example, faults in the insulation will be more readily located and the use of large fusible safety plugs, which act very sluggishly when of large cross-section, will be avoided. Fifty lamps should be the maximum number on a single circuit within a building.

Many plans have been proposed for the maintenance of an even potential, but the best made is to keep the percentage of loss in the wires very low. The only objection to the plan is that it involves very additional cost for large copper wires. This expense, however, is small in the wiring of a building in comparison with labor and other items of expense. There is another

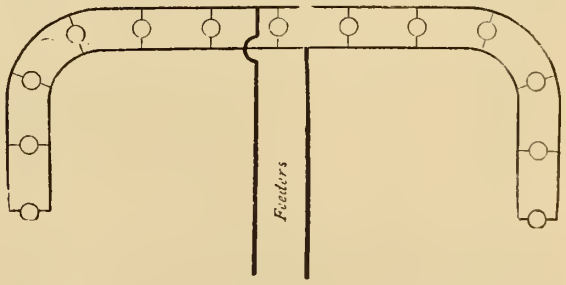


Fig. 8.—Location of Feeders.

reason why the loss within a building should be kept very small, which will be taken up in another chapter.

Fig. 6 represents a plan on which equal potentials must necessarily be obtained at all lamps.

Fig. 7 represents the so-called closed loop plan, with feeders diametrically opposite each other.

It might be stated that as a general rule in order to secure an equal potential, it is advisable to cross-connect the mains when-

ever possible and attach separate feeders at the centers of distribution.

Fig. 8 shows the proper location of feeders.

GAUGES IN CIRCULAR MILS AND SAFE CARRYING CAPACITY

TABLE No. I.

Circular Mils.	B.&S. Brown & Sharpe Gauge.	B.W.G Birmingham Wire Gauge.	E. S. G. Edison Standard Gauge.	Safe Carrying Capacity: Wire heated to 30 deg. F. above temperature of surrounding air. Number of Amperes.	Number of 55 Volt Lamps. 16 c. p.	Number of 75 Volt Lamps. 16 c. p.	Number of 110 Volt Lamps 16 c. p.
220,000			220	203	203	278	406
211,600	0000			197.3	197	270	395
206,116		0000		193.5	193	264	387
200,000			200	189.15	189	259	378
190,000			190	182	182	249	364
180,625		000		179.3	179	245	359
180,000			180	174.8	175	240	330
170,000			170	167.4	167	229	335
167,805	000			165.8	166	227	332
160,000			160	160	160	219	320
150,000			150	152.5	152	208	305
144,400		00		148.2	148	203	296
140,000			140	144.8	145	199	290
133,079	00			139.4	139	190	279
130,000			130	136.9	137	188	274
120,000			120	129	129	177	258
115,600		0		125.4	125	171	251
110,000			110	120.8	121	166	242
105,592	0			117.2	117	160	234
100 000			100	112.5	112	153	225
95,000			95	108.2	108	148	216
90 000		1	90	103.9	104	142	208
85,000			85	99.5	99	136	199
83,694	1			98.4	98	134	197
80,656		2		95.7	96	131	191
80,000			80	95.1	95	130	190
75,000			75	90 6	91	125	181
70,000			70	86	86	118	172
67,081		3		84	84	115	168
66,373	2			83.1	83	114	166
65,000			65	81.4	81	111	163
60,000			60	78.4	78	107	157
56,644		4		73.4	73	100	147
55,000			55	71.8	72	99	144
52,634	3			69.5	69	94	139
50,000			50	66.8	67	92	134
48,400		5		65.2	65	89	131
45,000			45	61.7	62	85	123
41,742	4			58.4	58	79	117
41,209		6		57.8	58	79	116
40,000			40	56.5	56	77	113
35,000			35	51.1	51	70	102
33,102	5			49.1	49	67	98
32,400		7		48.3	48	66	97
30,000			30	46.6	46	63	93
27,225		8		42 4	42	57	85
26,250	6			41.2	41	56	82
25,000			25	39.7	40	55	79
21 904		9		36	36	49	72
20,816	7			34.6	34	47	69
20,000			20	33.6	33	45	67
17,956		10		31	31	42	62
16,509	8			29.1	29	40	58
15,000			15	27.1	27	37	54
14,400		11		26 3	26	36	52
13,094	9			24.4	24	33	49
12,000			12	22.9	23	31	46
11,881		12		22.7	23	31	46
10,381	10			20.5	20	27	41
9,025		13		18.5	18	25	37
8,234	11			17.3	17	23	34
8,000			8	16.9	17	23	34
6,889		14		15.1	15	20	30
6,530	12			14 5	14	19	29
5,184		15		12.2	12	16	24
5,178	13			12.2	12	16	24
5,000			5	11 9	12	16	24
4 225		16		10.5	10	14	21
4,107	14			10.2	10	14	20
3,364		17		8.8	9	12	17
3,257	15			8.6	9	12	17
3,000			3	8.1	8	11	16
2,583	16			7.2	7	10	14
2,401		18		6.8	7	10	14

1. In this table it is estimated that 1 55 volt, 16 candle power lamp requires about 1 ampere of current; 1 75-volt, 16 candle power lamp requires about .73 ampere of current; 1 110-volt, 16 candle power lamp requires about .5 ampere of current.

2. Lamps supposed to be in multiple arc. On the three-wire system the same current in amperes will suffice for a series of two lamps. Hence twice the number of lamps as given in the above table can be safely carried on the same size wires.

TABLE No. 2.

ELECTRIC LIGHT CONDUCTORS.

I. Brown & Sharpe No.	II. Diameter. Mils.	III. Diameter. Millimetres.	IV. Square of Diam. Circular Mils.	V. Sectional Area. Square millimetres.	VI. Weight. Naked. Grains per Foot.	VII. Weight. Naked. Pounds per 1000 ft.	VIII. Insul. Pounds per 1000ft.	IX. Length. Naked. Feet per Pound.	X. Length. Insul. Feet per Pound.	XI. Resistance of pure copper wire at 75 degrees F. (23.89 deg. cent.) Ohms per 1000 ft.	XII Feet per Ohm.	XIII. Ohms per Pound (naked)
0000	460.000	11.684	211600.0	107.219	475.33	639.33	.....	1 56	.....	.051	19605.69	.0000798
000	409.640	10.405	167805.0	85.028	376.95	507.01	.....	1.97	.....	.064	15547.87	.0001267
00	364.800	9.266	133079.4	67.431	298.87	402.09	440.6	2.49	2.27	.081	12330.36	.0002012
0	324.950	8.254	105592.5	53.494	237.19	318.94	349.5	3.13	2.81	.102	9783.63	.0003200
1	289.300	7.348	83694.2	42.409	188.02	252.88	277.1	3.95	3.52	.129	7754.66	.0005102
2	257.630	6.544	66373.6	33.630	149.08	200.54	219.8	4.99	4.25	.163	6149.78	.0008111
3	229.420	5.827	52634.0	26.670	118.03	158.63	173.9	6.29	5.25	.205	4876.73	.0012897
4	204.310	5.189	41746.0	21.150	93.63	126.12	138.2	7.93	6.33	.259	3867.62	.0020513
5	181.940	4.621	33102.0	16.773	74.28	100.01	109.6	10.00	7.88	.326	3067.06	.0032615
6	162.020	4.115	26250.0	13.301	58.92	79.32	86.9	12.61	9.83	.411	2432.22	.0051858
7	144.280	3.665	20816.0	10.548	46.72	62.90	68.8	15.90	11.67	.519	1928.75	.0082474
8	128.490	3.264	16509.0	8.365	37.04	49.88	54.6	20.05	14.54	.654	1529.69	.0131119
9	114.430	2.907	13094.0	6.636	29.38	39.56	43.3	25.28	18.58	.824	1213.22	.0208353
10	101.890	2.588	10381.0	5.260	23.29	31.37	34.3	31.88	21.33	1.040	961.91	.0331402
11	90.742	2.305	8234.0	4.172	18.47	24.88	27.2	40.20	27.46	1.311	762.93	.0526969
12	80.808	2.053	6529.9	3.309	14.65	19.73	21.6	50.69	32.38	1.653	605.03	.0837705
13	71.961	1.828	5178.4	2.624	11.62	15.65	17.1	63.91	39.25	2.084	479.80	.1332
14	64.084	1.628	4106.8	2.081	9.22	12.41	13.6	80.59	49.21	2.628	380.51	.2118
15	57.068	1.450	3256.7	1.650	7.31	9.84	10.8	101.63	63.29	3.314	301.75	.3368
16	50.820	1.291	2583.3	1.309	5.80	7.81	8.6	128.14	67.60	4.179	239.32	.5355
17	45.257	1.150	2048.3	1.038	4.60	6.19	6.8	161.59	79.58	5.269	189.78	.8515
18	40.303	1.024	1624.3	.8230	3.65	4.91	5.4	203.76	92.46	6.645	150.50	1.354
19	35.890	.899	1288.4	.6528	2.89	3.78	4.2	256.26	107.83	8.617	116.05	2.277
20	31.961	.812	1021.5	.5176	2.29	3.09	3.4	324.00	110.25	10.566	94 65	3.423

* Approximate.

(To be Continued.)

BELTS FOR DYNAMOS.

THE success of electrical generating apparatus required high speeds, and to transmit the power a belt both light and strong was necessitated. The belt manufacturers, realizing the demand, devoted their energies to produce the desired article, and the double dynamo belt has been the result of the evolution. There are many makes of belts on the market, and even in the individual belts of the same make a difference in quality will be found. To make a durable belt for high speeds, writes "M," in *Electrical Industries*, the greatest care must be taken in preparing the stock, and the best of stock chosen, and dynamo belts are of this class. If a belt does its work satisfactorily, the engineer or operator of a station will call it a good belt, but if he should desire to make any comparison, or desire to use belts for other machinery, unless he made observation, he would have to refer to antiquated tables to figure his belting. How many engineers running stations know but little or nothing of the actual work their belts are doing.

The stretching of a belt means loss of power, a wasted expenditure of energy. The slipping or creepage of a belt is also another loss, and not one to be overlooked. The weight required is another loss. Poor belts that have to be made heavy to stand the strain are not desirable. No tables are prepared that will give the engineer any but approximate data, and even then the conditions are not considered. Every station man has the opportunity to compile some valuable information and be able to say why his belts are good, and to know what he can do with them in other cases. He should obtain the following: The length of the belt, the power transmitted, the speed of the belt, the weight of the belt, and the loss due to slippage and creepage; that is, the loss in the speed of the driven pulley, ascertained by finding its actual speed and the speed it would run should there be no loss. The strength of the belt, also the thickness and width of the belt. With this data he would know just what the belt was doing per unit of section, and would be able to figure up his own experience rather than upon the data of others who never knew what conditions he had to overcome or purpose he had in view.

NOTES.

An exchange remarks: The price of boiler material in this country fifty years ago was: Copper plate, 34 cents; iron, 16 cents; cast-iron, 6 cents per pound. Boilers were costly luxuries in those days.

Messrs. A. A. Dion, Moncton, N.B.; Albert J. Corriveau, Montreal; T. Ahern, Ottawa; Frederic Nicholls and Hy. S. Thornberry, Toronto, attended the recent convention of the National Electric Light Association.

A committee of the Council of St. Thomas, Ont., has been appointed to ascertain the cost of an electric fire alarm system. The purchase of an electric fire alarm will result in placing the city in class "A" for fire insurance purposes.

Mr. Charles D. Warren, president of the Metropolitan Street Railway Co., Toronto, in giving testimony recently before the Toronto street railway arbitrators said that since the introduction of electricity on their road their business had increased by one hundred per cent.

The following are the officers elect for the current year of the Canadian Marine Engineers' Association, Toronto: President, J. Baird; first vice-president, S. A. Mills; second vice-president, P. J. Kenney; members of council, Messrs. E. W. Fox, D. H. Fraser, D. L. Doley, J. J. Winnert and S. Gillespie,; treasurer, J. H. Ellis; secretary, F. E. Smith; auditors, C. E. Morgan, J. Harrington. The association is in a prosperous condition.

The system of municipal inspection of steam boilers appears to work satisfactorily in Montreal. Mr. E. O. Champagne, the civic inspector, reports that during the past year he made 1,381 visits of inspection, 689 examinations of boilers, 427 hydraulic tests, discovered 110 imperfect boilers, of which seven were condemned, attended to the erection of 37 new and 15 second-hand boilers, served 169 inspection and issued 393 certificates. During the year applications were made for certificates by persons desiring to take charge of stationary engines and boilers, of which 303 were granted. Mr. Champagne states that his work continues to increase, and congratulates the city on its immunity from accident. He also refers to the fact that the wharves, where formerly many unsafe boilers were used, are now under his jurisdiction, and the danger of accident thereby lessened. He indicates a number of amendments which he would like to see adopted.

The annual dinner of the Kingston branch of the Amalgamated Society of Engineers, held a few days ago, proved to be a very enjoyable affair. The chair was occupied by Mr. Thomas Barlow, the president.

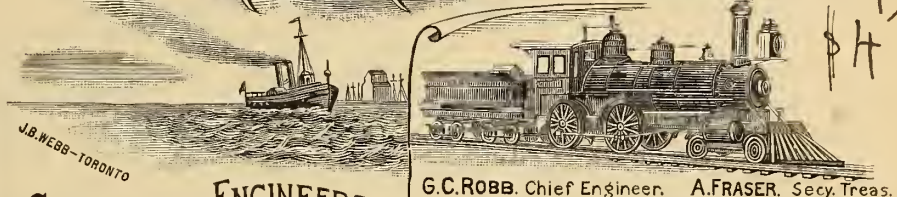
The C.P.R. Telegraph Company have just removed into new offices in the Toronto Board of Trade building. The wires enter by a tower on the roof and are distributed to the tables under a false floor, which is removable. The battery room contains 2,500 batteries, all in use.

Mr. Thos. Tickurr, of Parkhill, is the inventor of a diminutive steam engine, which works, it is said, with the accuracy and ease of a Corliss. The dimensions and capacity are as follows: Diameter of cylinder, 1-48 of an inch; weight, ½ of a gram; bore of cylinder, .3125 of square inch; revolution, 17.60 per minute; horse-power, .12,490 part of h. p. The "Little Jumbo," as it is called, is so small that it can easily be covered with the shell of a 22-calibre cartridge, being two-thirds smaller than the famous Waterbury engine that attracted so much attention at the Centennial.

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SPARKS.

The Edison General Electric Co. will supply the appliances necessary for the electric tramway at New Westminster, B. C.

New buildings and increased motive power have been added by the Royal and Ball Electric Companies to their plants at London, Ont., to enable them to carry out the contracts recently entered into with the city.

After ten years of construction, an elaborate telephone system, connecting all the forts and military establishments of Belgium with the city of Antwerp, has just been completed. The system was specially devised to prevent the tapping of the lines by an enemy in time of war.

Incorporation has been granted the Toronto Construction and Electrical Supply Company (limited), with a capital stock of $250,000 in 2,500 shares. The first subscribers are W. D. Matthews, W. R. Brock, Frederic Nicholls, Robert Jaffray, Hugh Ryan, H. P. Dwight and J. K. Kerr.

Mr. Jules Myers, engineer-in-charge of the construction of the Edison Company's new works at Peterboro', Ont., has gone to Milwaukee to supervise the execution of a contract for the Company. On the eve of leaving Peterboro' he was entertained by leading citizens at a banquet.

As regards their capacity for conducting electricity, the principal metals rank thus: Silver, 100; copper, 96; gold, 72; aluminum, 52; zinc, 26; platinum, 16; iron, 15; nickel, 12; tin, 11; lead, 7. Copper and iron are the only metals that have commercial value as electrical conductors.

The city council of St. John, N. B., recently decided that the New Brunswick Electric Co. should be given the contract to supply 123 lights on the east side of the harbor, and 25 additional lights for the north end. For supplying current to the latter a new 30 light dynamo will be purchased.

A correspondent writes to the *American Machinist*: Not long ago I turned off the commutator of an electric motor, and then proceeded to file it smooth with a single-cut file, but little particles of copper would stick in the cuts of the file and scratch the copper sections, so, after trying several other fine files with the same results, I finally thought of using the file backwards, which made a good job of it.

At the recent annual meeting of the Guelph Gas and Electric Company, a satisfactory report was presented. The increase in the electric light department has been satisfactory, and the incandescent lighting is growing in favor. A dividend of 3 per cent. for the half year was declared, making 5½ per cent. for the year. The skillful management of Mr. Yule received proper recognition from the directors. Mr. Guthrie was re-elected President, and Mr. Chadwick. Vice-President.

The electric tramway has scored another success at Victoria, B. C. A year ago some stout-hearted citizens in the face of numerous prophecies of failure, embarked their capital in the enterprise. The cars commenced running on the 22nd of February, 1890, and the event was followed by an appreciable advance in the prices of real estate lying contiguous to the new road. The city lines, which cover about five miles of the principal streets, have yielded a fair return since the opening day; and encouraged by the results in the city, the directors began the construction of the Esquimault division in July. On the 12th day of October this division was quietly opened without any flourish of trumpets or fuss, and has since been in successful operation. The Company have also made arrangements to supply electric light to the citizens. The total expenditure on all branches of the service, to the end of the year 1890, reached $200,000. The Company carried over their lines within a period of ten months, without serious accident, 720,000 passengers, and the financial results are understood to be satisfactory. It is said to be their intention to extend their lines during the coming summer.

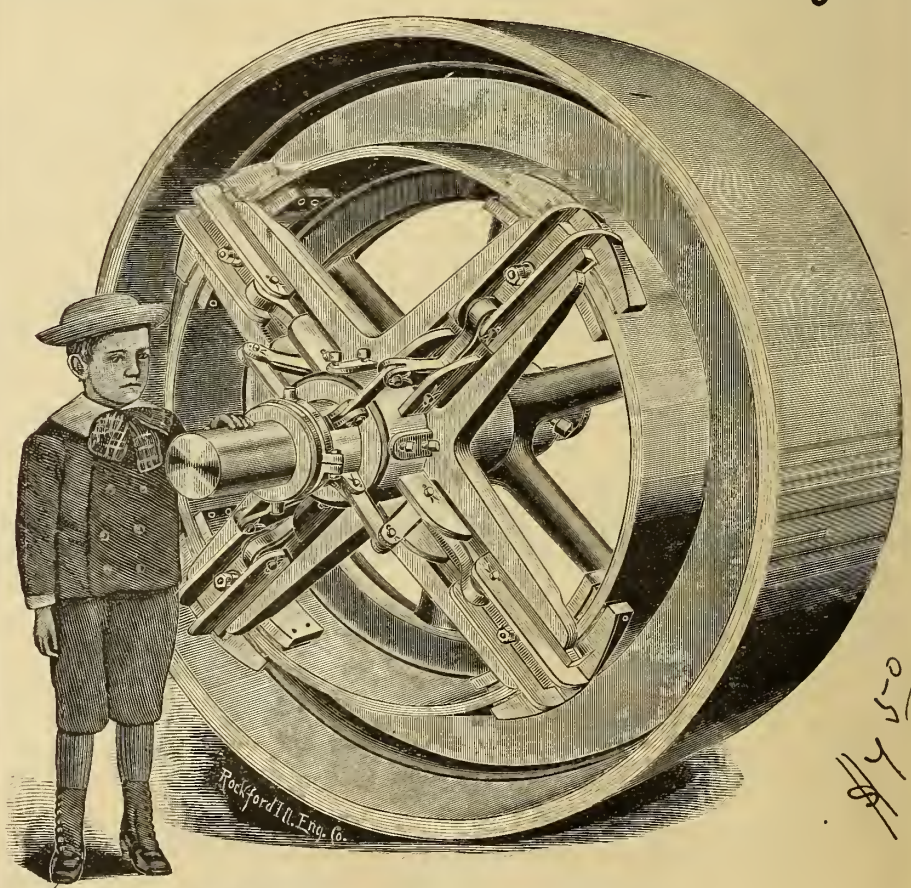
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For Electric Light Stations and all purposes where intermittent power is required.

MILLER BROS. & TOMS,
(Successors to Miller Bros. & Mitchell)
Toronto Office: 74 York Street, MONTREAL, QUE.
ESTABLISHED 1869.

SPARKS.

The Reliance Electric Light Company will locate in St. Catharines.

The Bell Telephone Co.'s line is to be extended from Shelburne to Orangeville, Ont.

The damage caused to the electrical industries of Connecticut by a recent storm is placed at $250,000.

A sixty-five horse power engine has been purchased in Toronto to run the Napanee electric light plant.

On January 31st the Royal Electric Company declared a quarterly dividend to shareholders of 2 per cent.

A new water wheel has recently been placed in position at the electric light station at Carleton Place, Ont.

The Peterborough Street Railway Co. have ordered five electric cars, and expect to have their line in operation this year.

Mr. W. S. Battin will, it is said, establish in Toronto a rival telephone company, charging a certain fixed rental and a small amount for each call.

On account of a series of mishaps the contractors for the electric lighting of Coaticook have been given an extension of sixty days to complete their work.

Mr. Harry Abell, son of Mr. E. R. Abell, of Selkirk, Man., is studying electrical engineering in Chicago, and is reported to be making rapid progress.

Mr. J. A. Culverwell, son of Mr. J. T. Culverwell, of Toronto, has received the appointment of contract agent with the Edison General Electric Company, Canadian district.

The Edison General Electric Company have leased a four storey brick building on Bay street, Toronto, which will be used as the business headquarters of the Company in Canada.

The Sun Life Assurance Co. are having an electric elevator, the first to go into operation in the city, put into their new building in Montreal, Messrs. Miller Bros. & Toms, Montreal, have the contract.

For accepting commissions from manufacturers who were desirous of supplying the city with electric fire alarm apparatus, Mr. Crawford has been dismissed from the position of city electrician of London, Ont.

The stockholders of the Edison General Electric Company, New York, ratified the action of the directors in increasing the capital stock from $12,000,000 to $15,000,000. It is stipulated that $1,000,000 shall be kept as a reserve fund.

The Bell Telephone Co. have 136 miles of wire and 271 instruments in use at Brantford, Ont. The daily calls average 2,000. At Kingston the Company have $30,000 invested. There ara 300 subscribers, 290 miles of wire and 3,000 feet of aerial cable.

The Abbe Leflamme, vice-president of the Royal Society, in an article on the census in Canada, strongly recommends a special return showing the progress of electrical enterprise in the Dominion. He further presses on the attention of electrical engineers the immense field that exists in the Province of Quebec for power suitable for small workshops such as electricity can supply.

ROGERS' DYNAMO OIL

Guaranteed Superior Quality and Economical.

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Finest Engine and Cylinder Oils.

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We have the following Leather Belts in use in the works of the Toronto Electric Light Co. :—

One 36 inch belt 98 feet long.
One 36 inch belt 100 feet long.
One 36 inch belt 123 feet long.
One 38 inch belt 100 feet long.
One 24 inch belt 100 feet long.
And over 1500 feet of 8 inch belting.

All of the above belts are DOUBLE THICKNESS. The 38 inch belt is the largest belt ever made in this Province.

We are prepared to furnish belts of any size, two or three ply, up to 48 inches wide. Every belt fully guaranteed.

SEND FOR DISCOUNTS.

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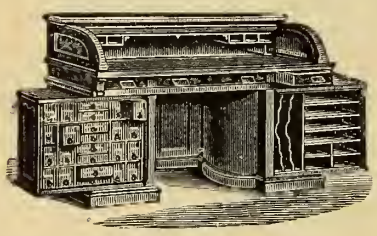
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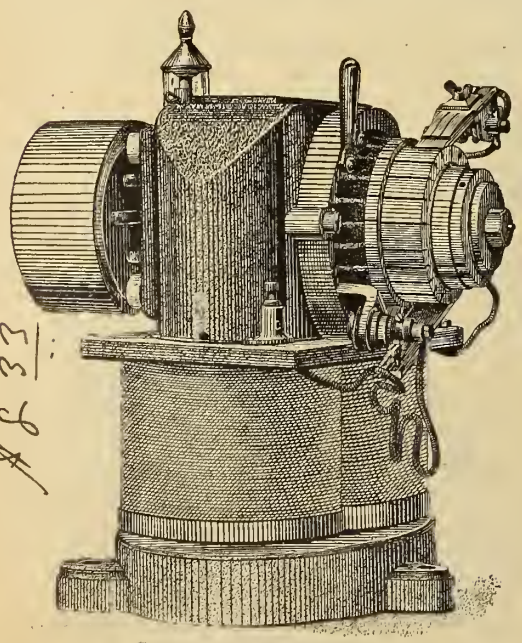
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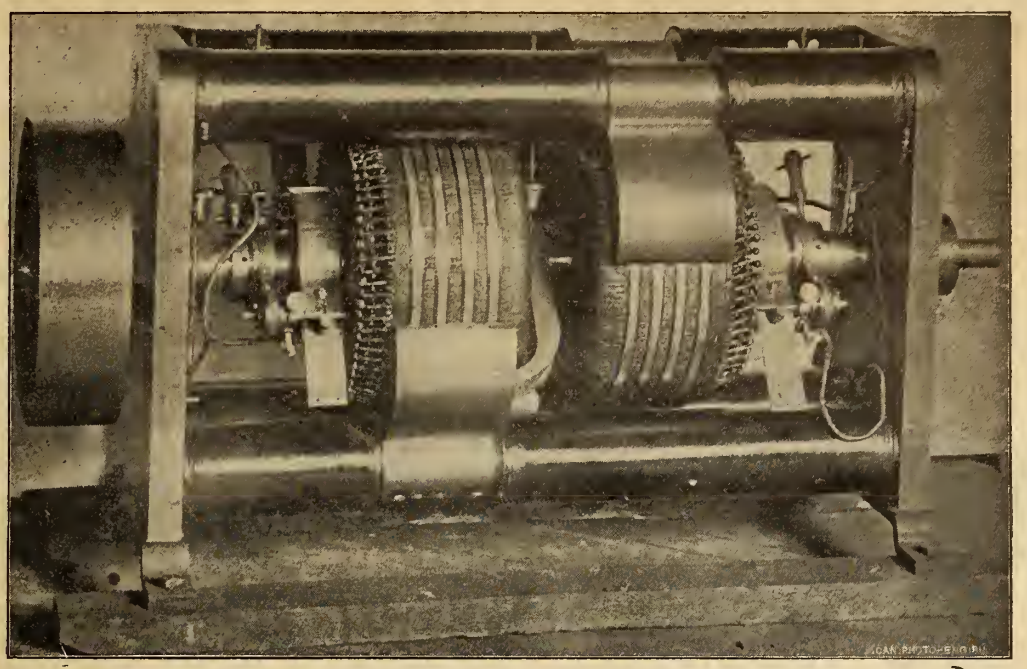
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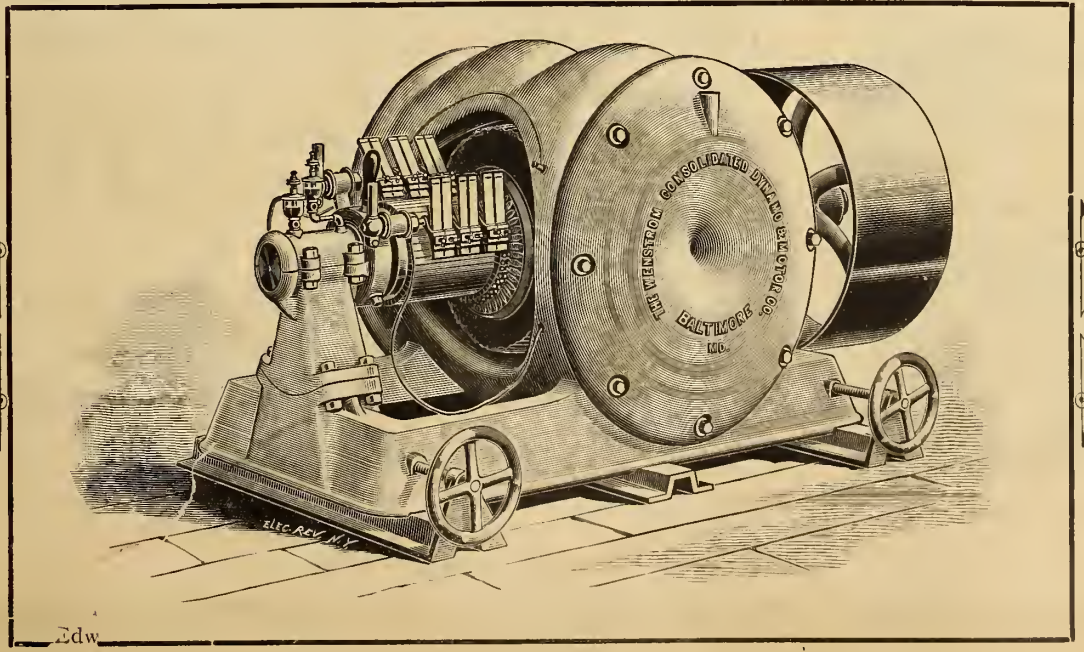
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THE BALL ELECTRIC LIGHT CO., LTD., OF CANADA.

Incorporated under Dominion Charter, 1882.

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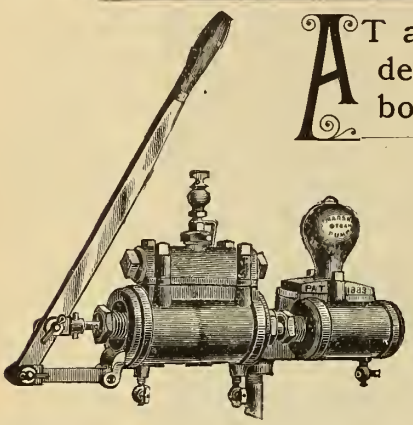


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MARSH INDEPENDENT STEAM PUMP

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OVER 2,000 MARSH PUMPS SOLD IN THE UNITED STATES DURING 1890



THIS CUT SHOWS SMALLEST SIZE MARSH PUMP, WITH HAND LEVER.

AT a recent test by Prof Cooley, of Michigan University, 48 degrees of temperature was added between condenser and boiler in passing through pump.

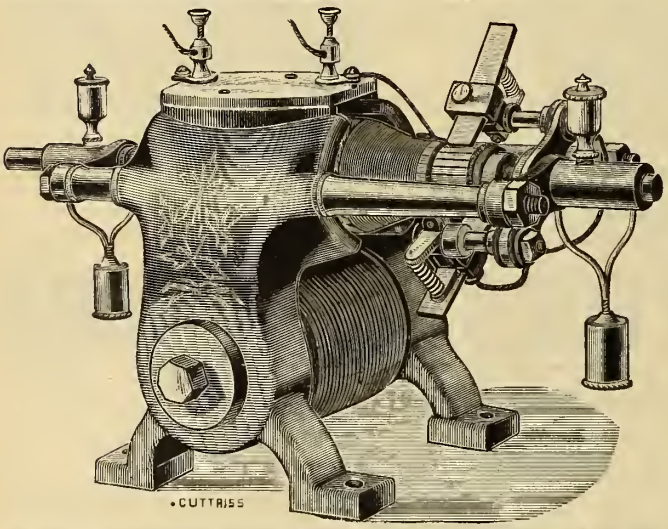
Absolute Actuation and Regulation without the use of Tappets, Levers, or other Mechanical Construction.

As the exhaust mingles with feed water and returns to boiler, there is no loss of heat, hence it is the most economical pump in use. For hot or cold water or liquids, with or without Hand Pumping Attachment, NO PUMP EVER MADE THE RECORD OR BECAME SO POPULAR AS THE "MARSH."

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For Arc and Incandescent Lighting.

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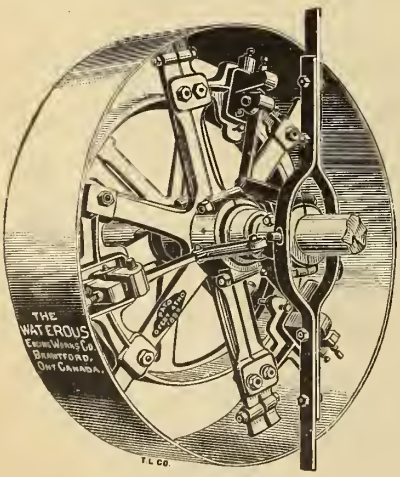
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WRITE FOR CIRCULARS.

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By lifting a tightner, throwing off the heavy belt, or stopping the engine? All of these are objectionable.



We have patented a Friction Grip Pulley,—compact, simple, durable, large frictional area, ample clearance when out of engagement, powerful gripping mechanism.

We guarantee this pulley to work satisfactorily and to be thoroughly reliable.

Made split when required, and with 2, 3, 4, 6 grips for any class of work. Also a Cut-off Coupling of the same design.

Send for circulars and prices.

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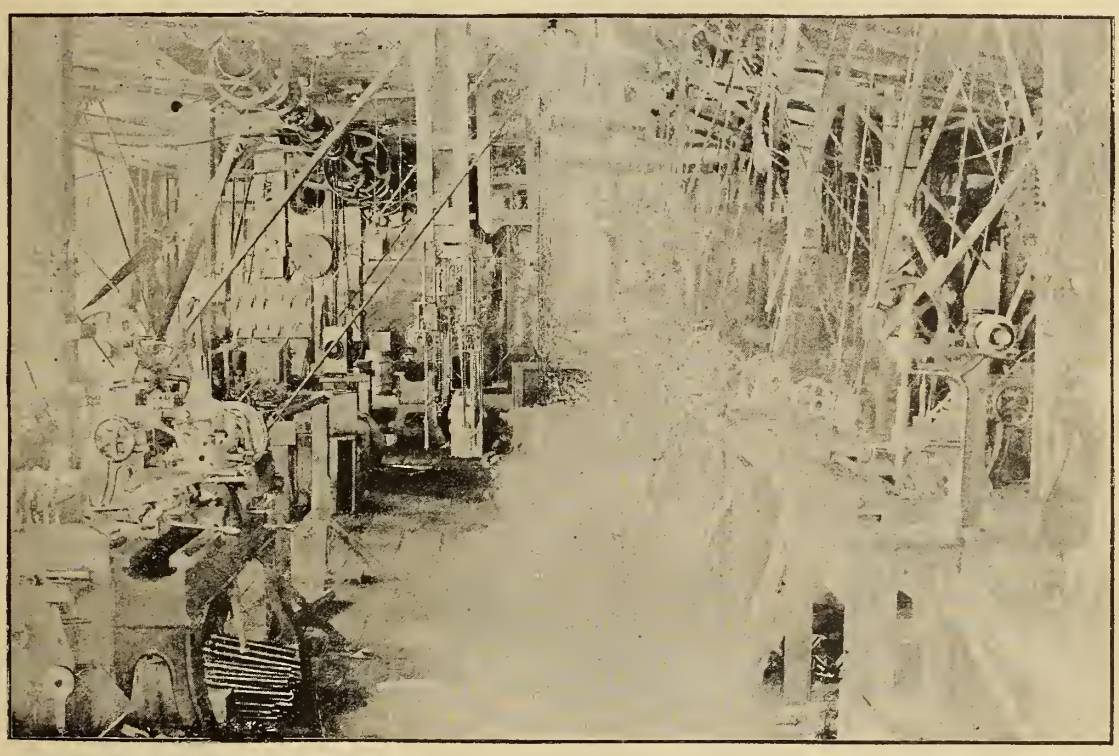
STEAM ENGINEERING JOURNAL.

VOL. I. TORONTO AND MONTREAL, CANADA, APRIL, 1891. NO. 4.

THE BALL ELECTRIC LIGHT COMPANY.

THE accompanying engraving shows the arc lamp and brass working department of the Ball Electric Company's factory, 70 Pearl street, Toronto. This represents but one floor. We will give illustrations of the dynamo and armature departments in a later issue.

The business of the Ball Electric Company has been steadily enlarging, and now covers all branches of electric manufacture, as they manufacture arc, direct and alternating dynamos and lamps, railroad and power generators and motors. They make many of the fittings in connection with the above, and carry a full line of light, railroad and power supplies. We would call the reader's attention to the Wenstrom incandescent dynamos, power generators and railroad motors, the Ball Company having recently secured control of this system for the Dominion of Canada.



ARC LAMP AND BRASS WORKING DEPARTMENT, BALL ELECTRIC LIGHT CO., TORONTO.

NEWLY-FLEDGED ENGINEERS.

THE following persons having successfully passed the necessary examinations, have been granted marine engineers' certificates :

First class—James H. Ellis, Toronto.

Second class—Samuel A. Mills, Toronto ; Eugene Belanger, Quebec ; Constant Hamel, Quebec ; William Parker, Kingston ; Samuel Gillespie, Toronto ; Alex. McRae, Toronto ; David Foley, Toronto ; Rupert McKay, Halifax ; James Baird, Toronto ; Oscar Flumerfelt, St. Catharines ; Charles A. Farrer, Meaford ; William F. Watts, St. Catharines ; William Whipps, Collingwood ; Edward W. Fox, Toronto ; Frank White, Toronto ; Andrew I. Foster, Halifax, N. S.; Alexander Cumstie, Halifax, N. S.

Third class—Matthew Hayes, Toronto ; William H. Linter, St. Catharines ; Alexander Barton, Kingston ; Albert E. House, Port Dalhousie ; George E. Wilson, Port Stanley ; Alexander McKenzie, Owen Sound ; David L. Johnston, Chatham ; Hiram F. Chute, Halifax ; Silas C. Soules, Queensville ; Lawson B. Cronk, Wallaceburg ; Henry Wilson, Victoria, B. C.; Amos Knox, Halifax.

Fourth class—Anthony Strong, Kingston ; John W. Hunter, Kingston ; John Bolton, Kingston ; William C. Spencer, Kingston ; William T. Hyde, Dresden ; John McDonald, Hamilton ; James Ryan, Westport ; James S. Adams, Toronto ; Alma Lawder, St. Catharines ; Andrew A. McLaren, Owen Sound ; William Harwood, Owen Sound ; John Burns, Owen Sound ; George W. W. Rankin, Owen Sound ; John H. Hewson, Owen Sound ; John J. Cawgill, Victoria B. C.; Samuel J. Giles, Toronto ; Robert W. Moore, Hamilton ; Bertram Meyers, Toronto ; Edmund J. O'Dell, Toronto ; Isaac Modeland, Victoria, B. C.

Electric Light : "Does your mother know you're out, Mr. Lamp Post?"

Lamp Post : "Oh, yes, and you're to blame for it, too, you stuck up thing that you are."

Electric Light : "Well, that's pretty strong now, but then, you always were a little gassy, and a little, *just a little light in the head*, you know."

Lamp Post : "You needn't talk, for you're a good deal lighter in the head than I ever was."

Electric Light . "Oh, thank you."—*Grip.*

THE WENSTROM DYNAMO AND MOTOR.

THE principal features of the Wenstrom and the advantages claimed for it by the manufacturers are :

(1). The iron clad field magnets, in which the magnetizing coils are surrounded by iron in every possible direction, so that the iron core may collect all of the exciting force, radiated from the coils, even that part which is usually dissipated in the surroundings. It follows from this arrangement that the exciting power is less in this machine, all other things being equal, because the power here is better utilized.

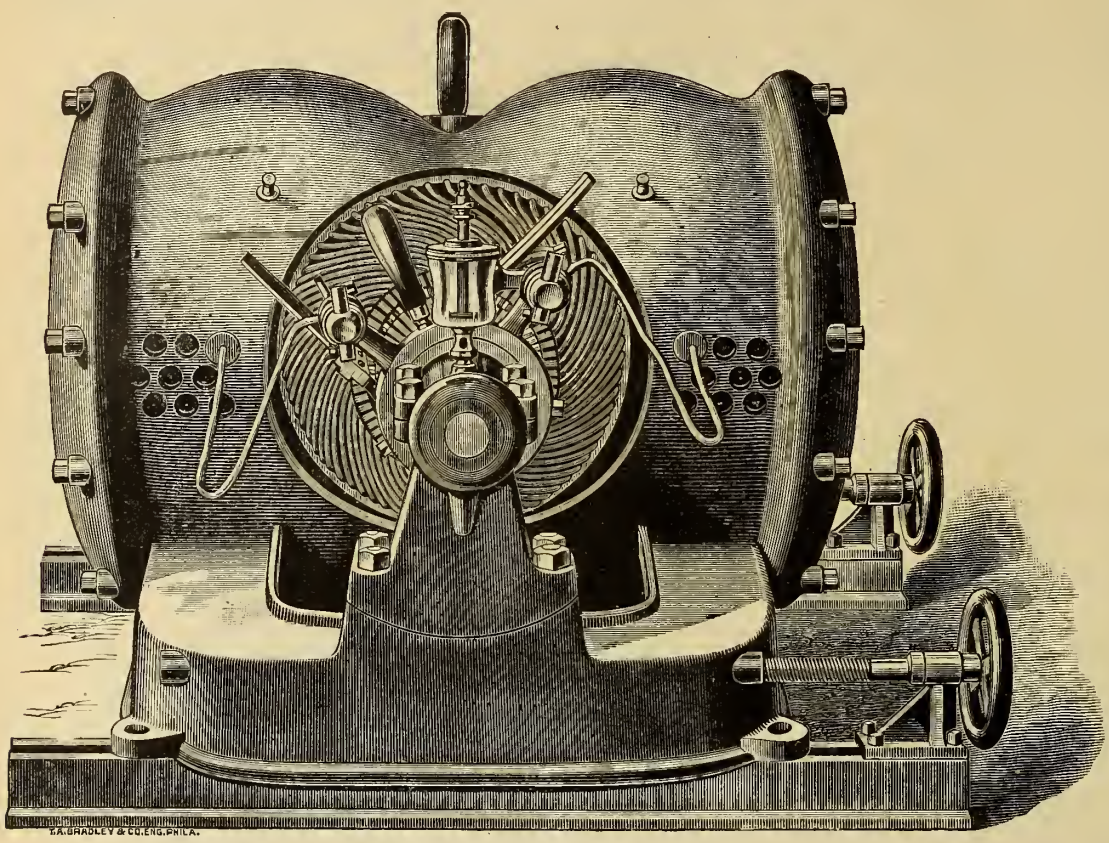


FIG. 1.—THE WENSTROM GENERATOR, (SIDE VIEW) SHOWING BRUSHES AND ARMATURE IN POSITION.

(2). The buried wire in the armature. In the Wenstrom the conductors are buried in grooves, or laced through holes transversely in the periphery of the armature, the distance between the pole piece and core being limited only to that small space required for the safe revolving of the armature. (See fig. 1.) The resistance of the magnetic circuit is by this means reduced in a high degree, and the magnetizing power used for creating the necessary magnetism in the armature is also decreased, thereby effecting a saving of power.

(3). Highest efficiency, in other words, the largest amount of light (or candle power of lamps) obtainable with the least amount of power received from the engine.

(4). Economy of operation.

(5). No sparking.

The base, cast solid with the body, is broad and long, giving a firm bed to the machine. The shaft is of steel, ground on dead centres and runs in composition—self oiling bearings, insuring perfect lubrication and reduced wear. The commutator is composed of massive copper bars, does not heat, and never needs renewal. Its covered structure precludes the possibility of an interruption from external injury, and there is no risk in transportation or handling.

All parts of the dynamo are easily accessible. There is no loss of external magnetism into the surrounding air, as shown by the utter failure to attract or magnetize bits of iron in proximity to or in the vicinity of the machine ; consequently, no magnetizing of watches or other delicate instruments when brought near it. For marine lighting this is regarded as an especially valuable feature, as it means no deflection of the compass, on account of the electric lighting plant. Heating is said to be avoided in the use of this machine, consequently a saving of otherwise wasted power, and endangering of insulation or stopping of the machine from such cause. By means of a perfect automatic regulation, it is claimed that any number of lamps less than the full load of the dynamo can be run with approximately the same economy of power per lamp, and any changes of the number of lamps burning can be made with perfect safety to the lamps and dynamo without requiring the attention of an attendant at the machine, and with the Wenstrom system lamps of various candle power can be used from the same circuit at the same time. The thoroughly insulated character of the dynamo, together with the low voltage used, is said to render the Wenstrom system especially desirable and safe for house, hotel or other lighting service.

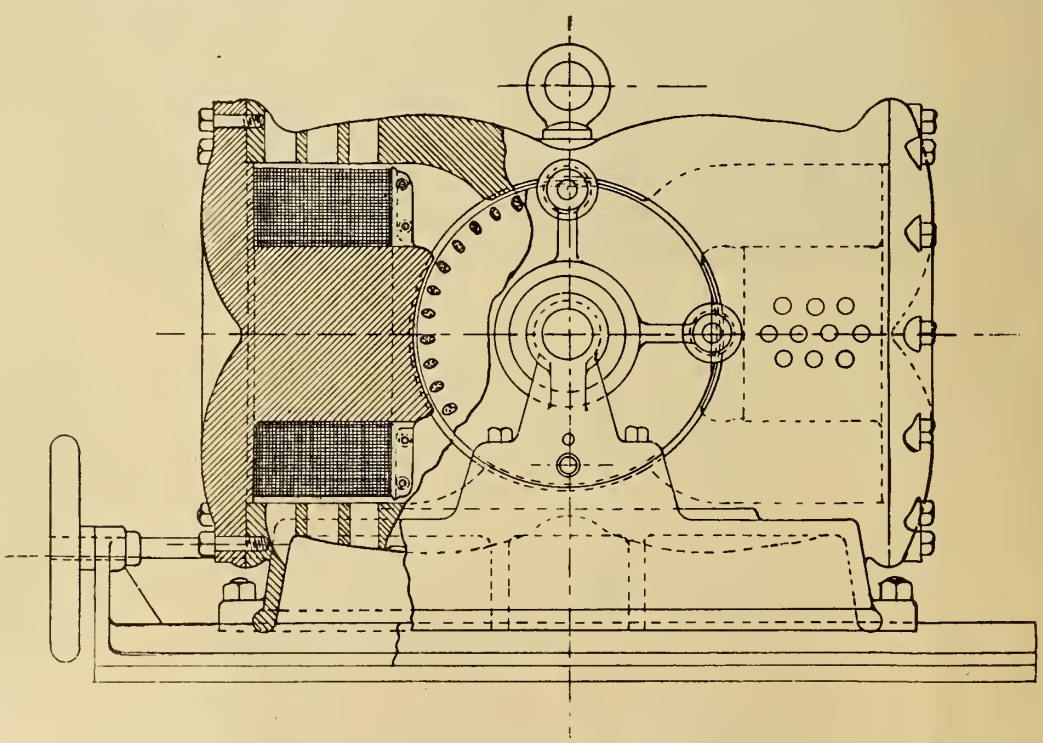
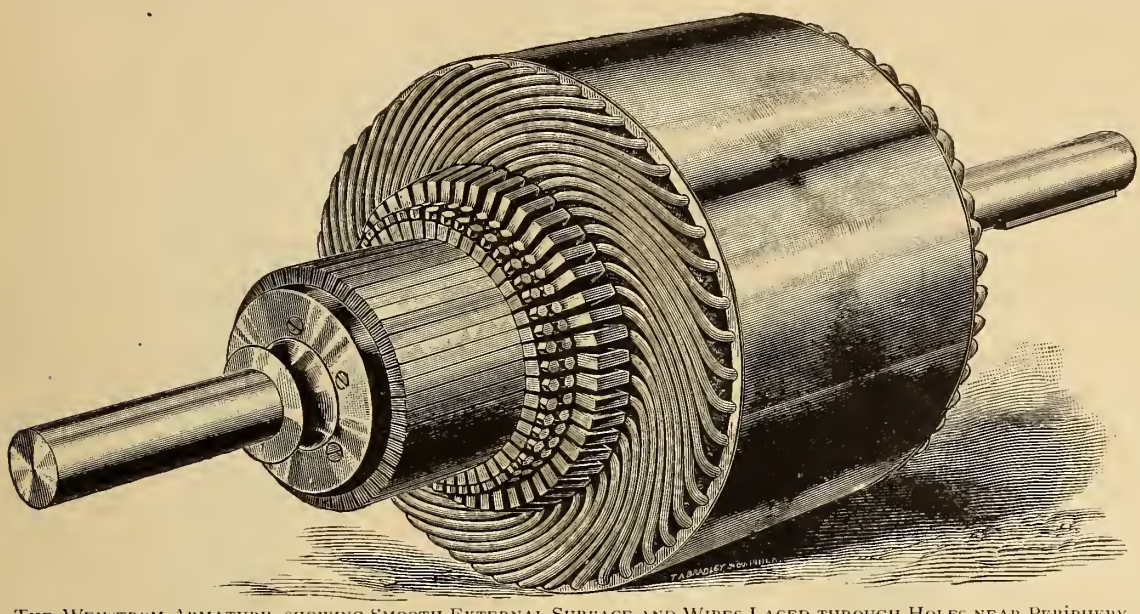


FIG. 2.—THE WENSTROM FOUR POLE GENERATOR (SECTIONAL SIDE VIEW) SHOWING FIELD COILS, POLE PIECES, ETC.

After a series of careful tests of the Wenstrom, Professor Kapp, the celebrated German electrician, writes of this machine as follows : "The Wenstrom possesses many novel and

remarkable points. It is very simply constructed and most substantially built, both as to electrical and mechanical details. Up to this time a machine has never been seen in this country which utilized all the magnetic forces as fully and undergoes so little loss of power as does the Wenstrom. It is impossible to utilize all such magnetic forces without the aid of two very essential points, which are the principal features of this machine. In all the best dynamos, as at present constructed, the manner



THE WENSTROM ARMATURE, SHOWING SMOOTH EXTERNAL SURFACE AND WIRES LACED THROUGH HOLES NEAR PERIPHERY.

of wiring the armature is such that it is impossible to bring the armature surface sufficiently close to the field poles to obviate the magnetic resistance, which it is very desirable to do. In all machines at present on the market, the old forms of field magnets have been strictly adhered to, and the currents produced by them generate magnetism in such a way that a large and valuable portion of it is generally lost. This, as will be readily perceived, it is very desirable to utilize, as, if it could be retained, more magnetism could be generated with less power. In the Wenstrom machine the desired end is attained by the peculiar construction of the field magnets and the cast iron shell, which while accomplishing the result demanded of it, also renders the dynamo more substantial and rigid in all its bearings. By this form the magnetic forces which are generally lost in other makes of machines are retained, while in the armature the two great obstacles are overcome by lessening the distance between the armature and the field, and by reducing the magnetic resistance to the core. The machine runs evenly and smoothly at extremely low speed. A careful examination of it will convince any one that it is the very best compared with other machines. In point of speed none can equal the Wenstrom, as it produces more current at low speed than any other can give at high speed. This machine has overcome some of the principal defects of other makes in speed, efficiency, weight and electrical and mechanical details, and no machine of equal capacity at present known could be manufactured as cheaply or run better."

THE "WENSTROM" SLOW SPEED RAILWAY MOTOR

is a four pole machine cast in one piece, being very simple in construction. The field coils are wound on bobbins which slide on to the main poles at either end of the motor. The construction of the armature is similar to that of the dynamo and generator, but its advantages are even more apparent for this work. There being no wire on surface of the armature, it is possible to run it within 1-16 inch of the field poles. The boxes are so arranged as to take up any wear, and by the same device the armature can be adjusted to 1-100 part of an inch. The difficulty of taking out the armature is obviated by making the pinion seat conical, so that the pinion can readily be taken off and armature slid out, taking but a few moments time, without any danger of injury to armature wires, which will be appreciated by persons who have had this difficulty to overcome. The Wenstrom motor complete weighs about 2,000 lbs., and it is claimed will develop 35 H. P., although the manufacturers have seen fit to rate it at 25 H. P. Its speed is only 400 revolutions per minute, which allows it to be geared to the car axle *direct*, without the annoyance and expense of the intermediate countershaft. Brush holders are arranged to slide on to the bracket so that they can be adjusted or taken off the motor entirely without removing the brackets. But one motor is used to a car, excepting in special cases where special grades, or work, renders two motors necessary, as it is an impossibility to construct two motors identical in power, speed and other details, the result being that where two are applied to the car axles, one does the greater share of the work ; therefore, while one is running light, the other is overworked and overloaded ; there are also twice as many parts to wear out and keep in repair. Owing to the low revolutions of the motor, it will give a maximum speed of 15 miles per hour (by one reduction and without use of a countershaft), and by use of patent *hydraulic* (noiseless wooden toothed gear) the armature is allowed at all times to run at full speed regardless of the speed of the car, and cannot be tied up or overloaded. By means of this hydraulic gear the speed of the car may be varied, without relation to speed of armature, which may be kept running all day. This also avoids the jerking in starting and stoppage of cars.

Further particulars will be cheerfully supplied by the Canadian manufacturing agents, THE BALL ELECTRIC LIGHT CO., LTD., Toronto.

TORONTO WATER SUPPLY.

THE Toronto water supply continues to demand a great deal of attention, and the daily papers are constantly referring either to the quantity or quality of the supply or the management or

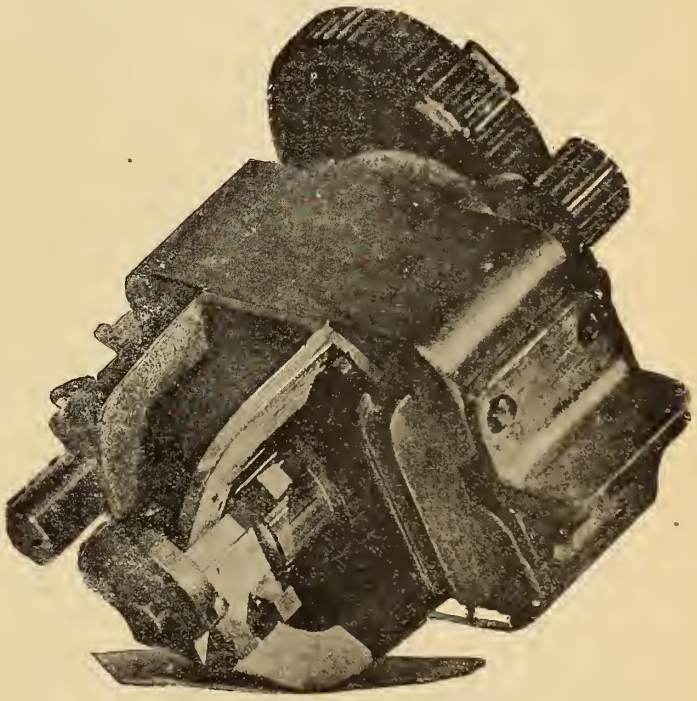


FIG. 4.—WENSTROM SLOW SPEED STREET CAR MOTOR.

mismanagement of the water works department of the civic government.

Public opinion, or the opinion of the public, seems favorably disposed to the idea of a supply running down hill instead of being pumped up, and no doubt if it can be got it will be a great improvement. Pure water and plenty of it should be supplied, and every householder should be made to pay for his share of

the water supply as well as for police protection, street cleaning, etc. The gravitation scheme, even if adopted, cannot possibly be in operation for several years, and the water is required now. A new pipe has been laid, but not yet completed, to bring the lake water into the well at the pumping house. The present pipe, which for over 4000 feet is only three feet in diameter, cannot let as much water into the well as the present engines can pump out of it. The present pipe has often leaked so badly at some point that bay water has got in. To many it seems a mystery how a pipe under water, but full of water, can draw water into it out of the bay. The reason is that the present pipe supplying the well is so small that before enough water can be got to flow through it to supply the pumps running at their ordinary speed, the water level in the well is about 13 feet below the level of the water in the lake. Hence the water pressure inside the pipe is less than that outside of it, and any joint not absolutely tight will permit bay water to enter. The new pipe is considerably larger than the present one, and when it is in use the water level in the well will be much higher, and the danger of leakage will be greatly reduced. Even if the new pipe should be found not absolutely tight, a very simple remedy could be found. By means of a centrifugal pump or a spiral pump, the water could be raised over on the island, and the well at the pumping house kept at a level a little above that of the bay. Any leakage then would be from the pipe into the bay. The water would be more easily lifted by the present pumps, and they would work more satisfactorily and pump a larger quantity. The *quality* of the supply would then be of undoubted purity, and by running the centrifugal pump on the island at a higher speed the *quantity* could be indefinitely increased as the public demand became greater. After the gravitation scheme has been settled, as in all likelihood it will be, to be doubtful as to quality and too expensive as to quantity, then the question of additional pumping stations will be sure to be raised. From one point of view it is a wise and economical plan to have the machinery all at one point and under one management. From another point of view it is most unwise and positively dangerous.

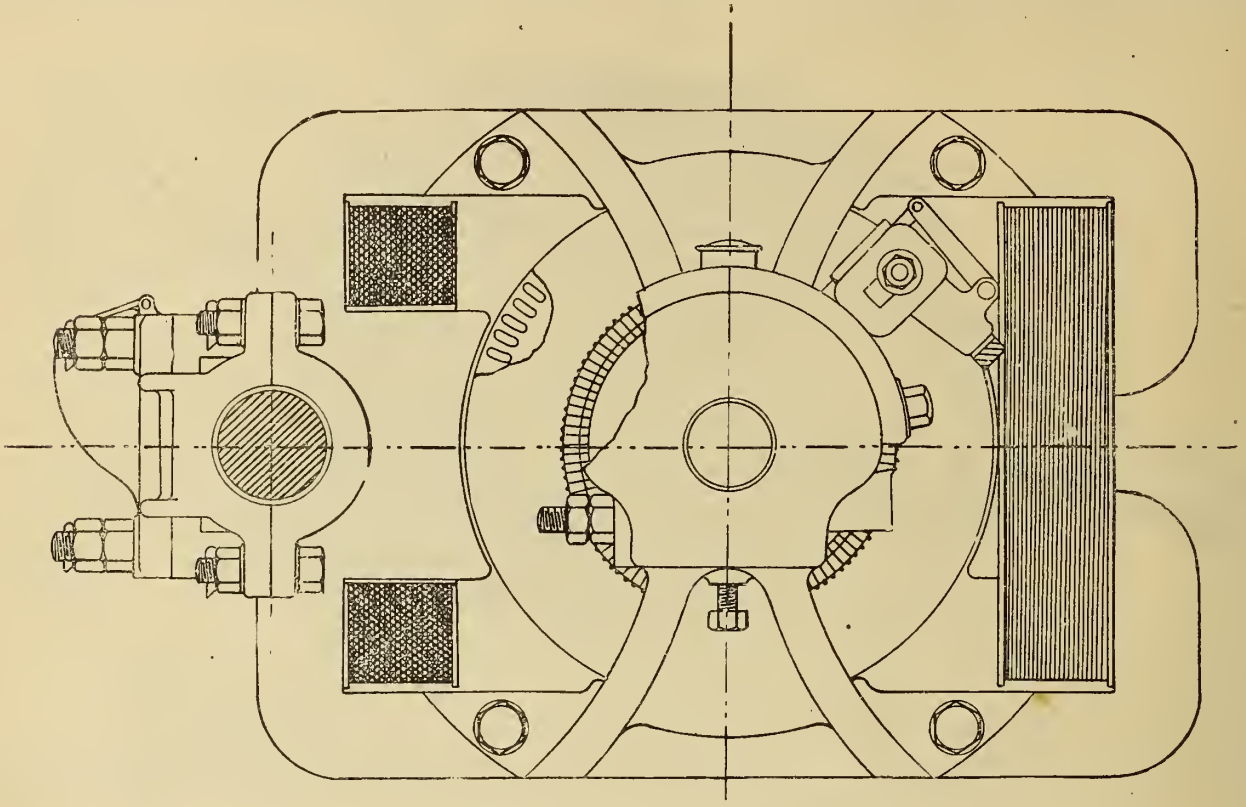


FIG. 5.—SECTIONAL VIEW OF WENSTROM SLOW SPEED STATIONARY MOTOR, GEARING DIRECT TO SHAFT.
[See description on pages 46 and 47.]

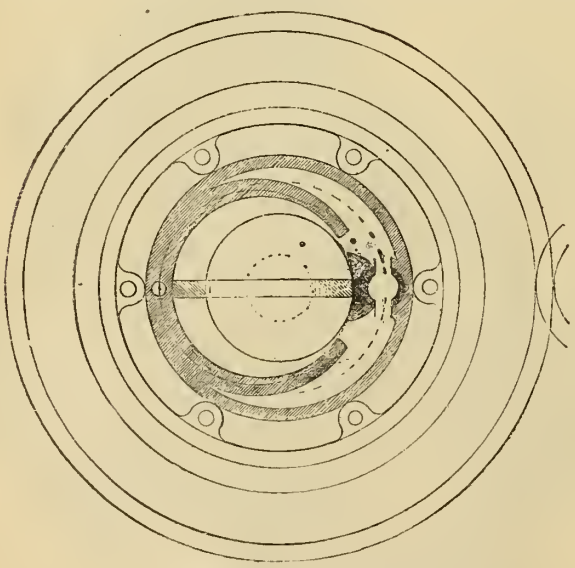


FIG. 6.—SECTION OF HYDRAULIC GEAR.
[See description on page 47.]

What would Toronto do for water should a boiler explosion occur at the main pumping station as disastrous as that in Quebec last month? One boiler exploding might do in a moment damage enough to destroy the buildings and to disable the machinery to such an extent that no pumping could be done for two or three weeks. Where would we get water? In some towns water is sold on the streets as milk is here. Imagine bay water carted through the streets and sold at so much per pint! There should be at least two complete and independent pumping stations, each large enough to supply the city, and so far separate that an accident or fire at the one would not injure the other. Each station should then be kept running at half its pumping power, and should one become entirely disabled, the other would be in order to go on in full power at once.

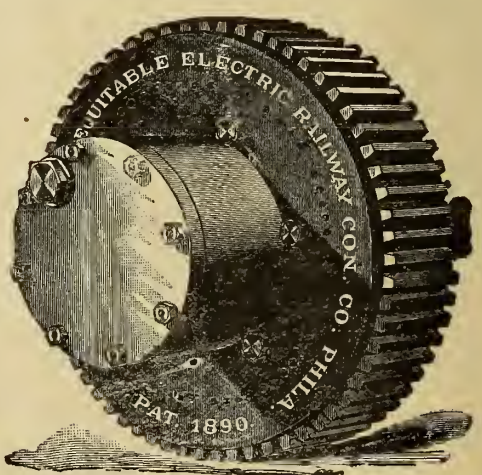


FIG. 7.—HYDRAULIC GEAR WITH INTERCHANGEABLE RUN AND WOODEN COGS.
[See description on page 47.]

The gravitation scheme advocate says: "Get our plan and there will be no boilers to burst and no engines to break down!" That may be, but the bursting of pipes and the breaking of water channels have led to as serious results and as long stoppage of supply as ever occurred by the break-down of a pump or the explosion of a boiler.

THE ELECTRIC CIRCUIT.*

THE electric circuit is the path or paths by which the current passes; and it must be complete from any given point, say the positive pole of the generator, through the wires, cables, etc., forming the external circuit, back to the negative pole of the generator, and through that to the positive pole from which it started. If any portion of the circuit be wanting; that is to say, if there be any place, or any body present in the path of the current, where the available E.M.F. cannot force any current through, then no current passes in any part of the circuit; and the apparatus which should have been actuated by the current does not work. A complete electrical circuit is sometimes spoken of as a *closed circuit*, and the operation of causing the current to cease is referred to as *breaking circuit*, or *opening circuit;* and again, a circuit in which no current is passing is sometimes called an *open circuit*. Thus, a dynamo machine is spoken of as being run on *open circuit*, when no work is being done in the circuit external to the machine. The same current—that is, the same strength of current in *Amperes*—passes in every part of a closed electric circuit; so that if a body whose resistance is comparatively high form part of the circuit, it will weaken the current passing in every part, in accordance with Ohm's law; and conversely, lowering the resistance of any part of the circuit will raise the current strength.

Though it has been stated that for all electrical action, or rather for the working of all apparatus requiring the passage of electrical currents, a complete electric circuit is necessary, it does not follow that there may not be more than one electric circuit; in fact, there may be as many of them as you like, and they may be arranged all to emanate from one source, or to branch out from other circuits. But no matter how many there are, the same rules hold good, viz., that no current will pass in any circuit—whether it be one of a number of circuits, a branch from another circuit, or a simple circuit by itself—unless that individual circuit is complete; and it follows, of course, that in the case of branches from a larger circuit the main circuit and the individual branch must be complete. Further, when a main circuit is divided into a number of branches, technically called derivations, the current in the main circuit divides between the branch circuits in the inverse ratio of their resistances, the branch having the highest resistance taking the smallest current, and *vice versa*. This again is strictly in accordance with Ohm's law.

A simple method of grasping the idea of an electric circuit, which the author has been accustomed to place before the pupils

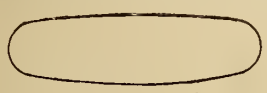


Fig. 1.

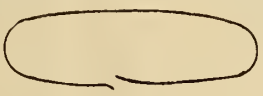


Fig. 2.

of his firm in the early days of their articles, is the following:—

Imagine a complete ring or hoop of wire, as shown in Fig. 1; and that an electro-motive force arises at some point in the ring of sufficient magnitude to generate a current. This current will go on circulating round the ring as long as the E.M.F. exists, and the wire remains intact. For simplicity, it is assumed that the ring is perfectly insulated from every other conductor, and that there are no branch circuits.

Now, suppose that we cut the ring of wire with a pair of pliers, at any convenient point, as Fig. 2. The current will no longer pass. Now, let us take a galvanic cell and connect its two poles—that is, the points at which the current can be taken from it—to the ends of the wire we have just cut, as Fig. 3. We have in the galvanic battery the source of electricity we require, and the current from it will continue to circulate through our ring of wire and our cell—which it must not be forgotten forms part of our circuit—as long as the cell continues to create an E.M.F., and there is no break in any part of the circuit, either in the wire loop or in the cell itself. But how are we to know that we have a current passing? Well, in some cases the action visible in the battery cell tell us, but not always; and, as we shall see later on, a battery may be consuming materials when no useful work is being done. Cut the wire in a second place and connect to the ends some apparatus that will denote the presence of the current furnished by one cell, against the resistance of our loop of wire; say an electric trembling bell, as Fig. 4. The current that will pass will be as the E.M.F. created by the cell, divided by the resistance of the circuit; that is, the combined resistance of the cell, the bell, and the connecting wire. If our bell is constructed to work with the current passing in our circuit, it will commence ringing, and will go on until either the battery ceases to create an E.M.F., there is a break in the circuit as before, or the resistance of some part of the circuit—say that of the cell itself—rises sufficiently to reduce the current below the strength at which the bell will work.

The question of the increase of the resistance of the battery will be dealt with later on; at present we will only consider actual breaks in the circuit. Cut the wire in a third place, and, this time, insert a push, as shown in Fig. 5, such as are to be seen in every optician or electrical apparatus dealer's window,

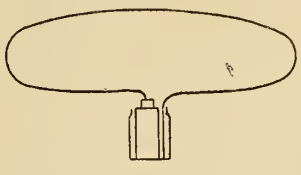


Fig. 3.

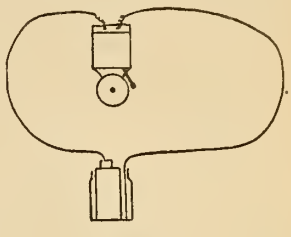


Fig. 4.

and which consist simply of two springs mounted on a board, and so arranged that the ivory button facing them, when pressed by the thumb, brings them into metallic contact; the ends of the two wires being connected to the two springs.

If we have carried out the above experiment carefully, the bell will now ring whenever we press the button of our push; and we have control of the bell as long as we have no other break in our circuit. It is obvious, of course, that the wire connecting the push, bell, and battery may be of any convenient length, provided that the battery, wire, and bell be so proportioned that the latter will ring with the current that passes. The reader will recognize the arrangement as that of an ordinary domestic electric bell.

But now cut our wire in a fourth place, and we shall find that we have lost the control of our bell, because we have another break in the circuit besides the one at push. (Fig. 6.)

Let us suppose, also, that our wire is covered with gutta-percha which we know has a very high resistance, and is, for most practical purposes, an insulator. Suppose that in any one of the connections we have made—to battery, bell, or push—we neglected to remove this covering before making our connection, we should find that we had no current passing; and the reason would again be, because, in accordance with Ohm's law, the resistance offered by the two thicknesses of gutta-percha was so great in proportion to the E.M.F. created by the cell, that no appreciable current could pass. Therefore, in all connections between wire and wire, or between wires and terminals or other

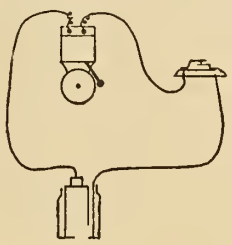


Fig. 5.

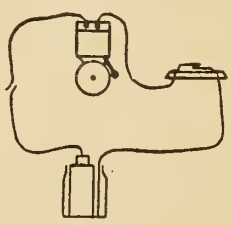


Fig. 6.

connecting pieces, we always first remove whatever insulating covering may be present, and we also scrape the wire bright, as dirt offers a higher resistance than copper. The reader must not imagine that gutta-percha offers an impassable resistance under all conditions; each case works out in exact accordance with Ohm's law. It was only because the E.M.F. of the cell was low, that the gutta-percha barred the passage of the current; if a high tension generator had been used, some current might have passed through the covering.

Let us attach wires to the bell and battery, and lead them to a second push, as shown in Fig. 7. We have now a circuit with two branches, the bell and battery being included in each, and we therefore control the action of the bell from either push, so long as there is no other break in the circuit. If there should

* Walker's "Electricity in Homes and Workshops."

be a break in that portion of the circuit between the bell and battery which is common to both branches, we lose the control of the bell from both pushes. If there is a break, other than that at the push, in either branch outside the bell and battery, we lose the control of the bell from the push belonging to that branch.

Even a break in the circuit itself acts strictly in accordance with Ohm's law. If no current passes, it is because the resistance interposed by the break is infinitely large, compared with the E.M.F. available. If the E.M.F. were increased very much, a current might still pass, as in the case of the electric spark, the arc lamp, and in a lightning discharge; the strength of the current in each case being strictly proportional to the E.M.F. divided by the resistance; but it is always necessary to be sure that we have *all* the resistance of the circuit included in our calculation. Not infrequently the resistance of the generator itself, of the body from which the current proceeds, is of very great importance. Often, too, matter which we do not want, such as dust or dirt, interposes itself in the circuit, and before we can apply the law correctly, we must know this resistance, and it must take its place in our calculations.

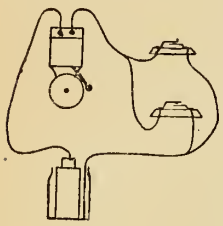


Fig. 7.

It may perhaps be as well here to give the rule for determining the joint resistance of two or more derived or branch circuits. Supposing that we have a source of electricity, with a certain E.M.F. available at a certain point, from which branch out several derived circuits, as they are called. The current in each branch is determined strictly by reference to Ohm's law; that is, the E.M.F. being the same, all we have to do is to divide it by the resistance in each case. A dynamo feeding a number of incandescent lamps is a familiar instance, and easily understood. Suppose that the E.M.F. is the same at the terminals of all the lamps; then, if the resistance of each lamp is the same, the current passing through each will be the same; but if their resistances be different, as when they are of different candle-powers, or different patterns, then we calculate the current in each case by the formula; and having obtained all the currents, add them together, and apply the formula $R=\frac{E}{C}$ to the whole, and we have the joint resistance of the group.

To take an example, suppose we have a dynamo, or an electric light service with 100 volts difference of potential, and that we have lamps whose resistances when burning are respectively 400 Ohms, 200 Ohms, 100 Ohms, 50 Ohms, 10 Ohms. These lamps will take ¼ Ampere, ½ Ampere, 1 Ampere, 2 Amperes, and 10 Amperes. The sum of these $10+2+1+5+\cdot25=13\cdot75$ Amperes, and their joint resistance $=\frac{100}{13\,75}=7\cdot57$ Ohms.

The joint resistance of a number of branch circuits, whose resistance is equal, as, say, a number of incandescent lamps, all of the same pattern and of the same candle power, is found by simply dividing the resistance of one branch by the number of branches; thus, if we have 20 lamps, each of 200 Ohms resistance, their joint resistance is equal to $\frac{2\,0}{2\,0}=10$ ohms, when they are arranged as branch circuits emanating from the same points. Of course, in actual work, you do not always have all the branches emanating from the same points, and it is therefore generally more convenient to calculate the currents than the resistances.

For two branch circuits of unequal resistance, the joint resistance may be found by multiplying their resistances together, and dividing the product by their sum. Thus, if we have two resistances 10 and 2, their joint resistance $=\frac{10\times2}{10+2}=\frac{20}{12}=1\cdot6$ Ohms. For any number of branch circuits greater than two, the formula becomes somewhat complicated, and the method given above, of finding the current strength in each case, will be found simpler.

This matter will be explained more fully when dealing with electric lighting circuits. It may be mentioned, however, that the rule applies to such branch circuits as the insulation of telegraph or telephone lines, and to that of cables for electric lighting or transmission of power; each unit of length, say a mile, or a hundred yards, and each pole, being considered as a separate branch. Thus, if the insulation resistance of a telegraph or telephone line—that is to say, the resistance between it and the earth—be 1,000,000 Ohms for 1 mile, for 1,000 miles it would only be 1,000 Ohms, and the leakage path, as will be explained later, would be very serious, as, with ordinary telegraph wire, it would be less than that of the proper conducting path.

The Earth.—In connection with the electric circuit, the Earth, or Ground, as the Americans term it, often plays a very important part.

It has been explained that the electric circuit consists of a path, from the generator, through the apparatus that is to be worked and that which is to work it, back to and through the generator itself. It will be seen that the apparatus to be worked—the bell, lamp, or whatever it may be—and that which is to control it—say the push, key, or switch—may be some distance apart. This requirement would necessitate two wires or conductors between the two places, unless some other path could be found that would perform the office of one wire, and carry the returning current.

The crust of the earth, a river or stream, the metals of a railway, the water and mud of a dock, the gas or water service of a town, may each form this path, and thus save one wire or cable. But it must be distinctly born in mind that "earth," or "ground," as anything which answers this purpose is technically called, is subject to Ohm's law, exactly as the wire or cable which forms the other part of the circuit is. If the resistance of any part of the earth circuit is high, it will weaken the current, exactly as a bad joint would, or a small wire. Thus, if you make connection to the gas-pipe, and there happens to be a *good gas* joint; but, as often happens, a bad electrical joint; between one of the feed pipes and the main you get what is technically known as "bad earth;" or, in other words, you have a resistance in the circuit that you had not bargained for, and which must be avoided if possible. So also with reference to the rails; if the connections between the rails at the fish-plates are not electrically good, a like result will follow.

It must be borne in mind, too, that the resistance of the earth circuit must be proportionate to the current that is to pass. Thus, what would be good earth for a telephone current may be very bad earth for an electric-lighting current. Very large iron water pipes, even, might offer so much resistance at their joints as to be quite unsuitable for electric-lighting currents of even moderate strength.

Another important point in connection with earth is its variability under different physical conditions. If the crust of the earth be used, for instance, in very dry weather, or in frosty weather, the resistance may be almost infinite, as the conducting path consists of the moisture in the pores of the earth. Again, a dock with 20 feet of water in it would afford a good conducting path, whereas the dock empty might not.

It will be easily understood, too, from what has been said on the laws of resistance, that it is of importance to have a large surface in contact with the earth, or whatever may be used for a return, as the resistance offered by the earth will vary directly as the distance between the two surfaces, and inversely as their sectional area. It is also of importance that the earth-plate should be proportioned to the current that is to pass, and that it should be subject to as little chemical action as possible. Under the very best conditions there will be some resistance at the surface of the plate, where it is in contact with earth; and that resistance will generally increase, owing to chemical action. It is therefore wise, in laying down electrical apparatus, when using earth, to allow for this, and to make your earth connections very much larger than they otherwise would have to be, or than a consideration of theory simply would dictate; that is to say, the theory that would apparently apply at the time the plate was laid down.

The earth is, of course, subject to the same laws of derived circuits as other conductors; and we may expect that if a portion of the earth's crust, or a stream, gas or water service, form part of several circuits, portions of current from one circuit will occasionally find their way into other circuits; and accordingly we find this the case with telephone circuits, it being most difficult to prevent messages being heard in wires not intended for them, owing to their passage by earth. This is always more marked where earth is bad, or of high resistance.

(To be Continued.)

STRATFORD BRANCH C. A. S. E.

CONTINUING our sketches of the Presidents of the various branches of the Canadian Association of Stationary Engineers, we have the pleasure this month of presenting to our readers a portrait of Mr. John Hay, who ably presides over the destinies of the Stratford branch. Mr. Hay's acquaintanceship with the steam engine dates back some seventeen years, during which period he has been laying up a store of practical knowledge which is the foundation of his present efficiency.

The other officers of the Stratford Association are: Messrs. S. H. Meir, Vice-President; W. Bates, Secretary; A. McArthur, Treasurer; P. A. McDonald, Conductor.

The Association has suffered the loss of a considerable percentage of its membership, owing to the removal from the city of a number of the members, but it is gratifying to know that notwithstanding these discouragements, the remaining members of the organization are pushing forward the work of self-improvement which it was designed to accomplish."

THE VALUE OF A CONDENSER.

IT is sometimes difficult to decide whether a condenser attached to an engine will pay or not. At first sight one is apt to at once declare, "Why, of course if a condenser will add 25% or more to the power of the engine or diminish the fuel bill that much, it must pay!"

In the early days of the steam engine as a practical machine, the condenser played a most important part. At first the steam cylinder itself formed the condenser, and in 1769 James Watt obtained a patent for improvements in "fire engines," of which the following were some of the claims;

"*First.*—That vessel in which the "powers of steam are to be employed "to work the engine, which is called "the cylinder in common fire engines, "and which I call the steam vessel, "must during the whole time the en- "gine is at work be kept as hot as the "steam that enters it; first, by enclos- "ing it in a case of wood or any other "material that transmits heat slowly; "secondly, by surrounding it with steam "or other heated bodies; and, thirdly, "by suffering neither water nor any "other substance colder than the steam "to enter or touch it during that time."



MR. JOHN HAY, PRESIDENT STRATFORD BRANCH, C. A. S. E.

"*Secondly.*—In engines that are to "be worked wholly or partially by con- "densation of steam, the steam is to be "condensed in vessels distinct from the steam vessels or cylin- "ders, although occasionally communicating with them; these "vessels I call *Condensers;* and whilst the engines are work- "ing, these condensers ought at least to be kept as cold as "the air in the neighborhood of the engines, by application of "water or other cold bodies."

"*Thirdly.*—Whatever air or other elastic vapour is not con- "densed by the cold of the condenser, and may impede the "working of the engine, is to be drawn out of the steam vessels "or condensers by means of pumps, wrought by the engines "themselves, or otherwise."

From these claims it will be seen that Watt had a clear idea of the economical working of a steam engine, even before any such were in existence. In his fourth claim he describes a non-condensing engine discharging steam into the atmosphere, and, of course, using steam of a higher pressure.

In the early condensing engines the pressure of steam used was very low, and the withdrawal of the pressure of the atmosphere by means of the condenser was really the main source of the power of the engine. Steam of two or three pounds pressure raised the piston in a large cylinder which was open to the air on the other side of the piston. When the top of the stroke was reached, the valve opened, the steam escaped to the condenser, and a vacuum being formed on the under side, the weight of the atmosphere forced the piston down. These single acting engines were chiefly used for pumping water out of mines. In a later style of engine, also patented by Watt, the double acting engine was produced, and another of Watt's patents describes the expansive use of steam in the cylinder.

It will be apparent that with the low pressure of steam used, the condenser was of great advantage, but the point now to be considered is: Having steam of from 90 lbs. to 100 lbs. on the boiler and an automatic cut-off engine, will it pay to add a condenser? The answer to this problem can only be correctly solved by considering what use can be made of the exhaust steam, and what it will cost to get water enough to work a condenser. Sometimes the exhaust steam can be utilized during part of the year for heating buildings; and in factories where large quantities of hot water are used, for heating water. If water for condensing can be had cheaply, in most cases it would pay better to use a condenser, and taking the water from the condenser at about 120° temperature, feed the boilers from this and use live steam to heat the buildings and the water. But if water has to be bought, as is often the case in cities, it will require a careful calculation to determine at what price for water will a condenser cease to pay.

Let us suppose a case of an engine indicating eighty horse-power. No use can be made of the exhaust steam except to heat the feed water, and water for condensing purposes can be had at 20 cents per thousand gallons. Will it pay to use it?

A non-condensing engine with a good feed water heater, and using steam expansively as is commonly done, will in every day work require about thirty pounds weight of steam for each horse-power per hour. With the ordinary boiler efficiency, this means a consumption of coal for eighty-horse power of about thirty-six hundred (3600) pounds per day.

The same engine with a condenser attached would use about twenty-two pounds weight of steam for each horse-power per hour, and the consumption of coal would be about 2460 lbs. per day for eighty horse-power. The condenser would require a supply of water of about 50,000 gallons per day more than the amount required to feed the boilers. The saving effected in coal was shown to be not quite half a ton per day, amounting in value to a little over two dollars, taking coal at $4.40 per ton. The water used to effect this saving amounts to 50,000 gallons, and if bought at 20 cents per thousand gallons would cost ten dollars, making a loss of eight dollars per day without adding anything for interest on the additional cost of the condenser or for "wear and tear."

If the water can be had for the pumping, by having the engine and factory close to a river or lake, a condensing engine will in most cases be the more economical one to use, and where there is any doubt about its economy, it would be better to attach an independent condenser and arrange the engine to be run either with or without the condenser.

In the winter time the exhaust steam might be utilized for heating purposes, and in the summer time the condenser could be used.

TRADE NOTES.

Mr. G. W. McCrae, of Montreal, has received an order from the St. John's, Que., Electric Light Co, for a 150 h. p. triple expansion engine to drive their electric plant. This is said to be the largest engine ever built in Canada on this principle. The maker guarantees a saving of 20 per cent. in the quantity of coal used.

The Dodge Wood Split Pulley Co. advise us that the introduction of the dynamo and motor has materially increased the demand for high class pulleys, and that they are daily in receipt of special orders for pulleys to run at high speed for electrical purposes, and that in addition to their regular wood split pulley, they make a specialty of an iron centre pulley with fine hard maple face, which has given excellent service where a great amount of power is required at high speed. They report recent large orders from the Toronto Electric Light Co, Toronto, and Saint John Gas & Electric Light Co., St. John, N. B., as well as many others, and invite correspondence from all in need of anything in this line.

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EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

MR. W. C. MCDONALD, of Montreal, has placed the youth of Canada under deep obligation to him by his recent bequest of $40,000 for the endowment of a chair of electrical engineering at McGill University. Thus the means has been provided by which our young men may obtain the knowledge they require without being obliged as heretofore to go beyond the bounds of their own country. We learn that the electrical laboratories in the new building, now in course of erection, will contain all the necessary apparatus and facilities for electrical work, and the classes of the professor of experimental physics with all the apparatus at his disposal will also be available for the instruction of the students in this department.

ACCORDING to experiments made by Dr. Tatum, of Yonkers, N. Y., with an alternating current machine of high frequency, namely, of some 8000 alternations per second (the usual frequency of alternations in commercial machines at present in use being 300), he finds that the physiological effect, or in other words the power to kill, with any given strength of current, decreases in proportion to the frequency of the alternations, and that even at 4500 alternations, the effect is less than that of a continuous battery current. It would be curious if this very property of alternation which has usually been considered an element of danger, should eventually be the means of rendering high-tension currents comparatively safe.

AN interesting calculation was given by Mr. Gisbert Kapp in one of his recent Cantor lectures which is full of significance to the electrician and engineer. It was regarding the distance that power could be carried by means of a storage battery from a waterfall, the batteries being carried on a tram-car, using the electricity from the batteries as motive power, compared with the distance that coal and corn could be carried with a similar loss in transmission—in this case 10 per cent. The corn would be hauled by a horse that lived on it as he went along, and the coal by a locomotive using it for fuel. The distance attained with a 90 per cent. efficiency in transmission would be: for the coal and steam engine, 1,300 miles; corn and horse, 440 miles; and storage battery and motor, 26 miles.

THE Barking Road Tramway, London, on which cars are used driven by storage batteries as a motive power, is frequently instanced by friends of that method as proving the adaptability of storage batteries for street car propulsion. We do not think that anyone doubts that storage batteries can be used to push a street car. That has been frequently demonstrated. The vital question is, can it be made to pay? If it is not *commercially* practicable, it must fail. On that road it takes 2½ tons of batteries to move 3½ tons of passengers. The car takes at times 17 h. p. at the car, with an average of 7 h. p. delivered at the axle of the car when running. This costs, with the cheap fuel and labor available, over 16 cents per car mile, or about four times as much as horse power on the Toronto street railway.

THE city of St. Catharines is about to lose a valuable industry by reason of the stupidity of the gentleman who acts in the capacity of City Solicitor. When it was proposed to submit a by-law to the ratepayers authorizing the granting of a bonus of $9,000 to aid Messrs. Patterson & Corbin to erect a factory for the manufacture of electric cars, the solicitor's opinion was asked as to the proportion of votes required to legally carry the by-law. He replied that a majority of votes would be sufficient. The voting resulted in a majority being obtained for the by-law. While the Council and citizens were congratulating each other on the result, the City Solicitor announced that on further consideration of the matter he had discovered that to render the by-law legal, a majority of two-thirds of the votes cast must be secured in its favor. It is not surprising that everyone now feels disgusted with the situation. Messrs. Patterson & Corbin are understood to have selected a site for their factory at Peterboro'.

THE executive committee of the National Electric Light Association has fixed the 25th, 26th and 27th of August as the date of the next convention to be held in the city of Montreal. The convention will take place in Windsor Hall. The Victoria rink will contain the exhibition of electrical apparatus. The civic authorities and citizens of Montreal will leave nothing undone to make the occasion one of pleasure and interest. We have heard that it is the intention of one of our leading electrical companies to rank amongst the exhibitors, and no doubt the others will do likewise. We believe strong efforts will be made to induce electrical men in Canada to become members of the National Association on the occasion of this convention. Without wishing to detract from the benefits which might accrue to them from such a course, we are strongly of the belief that the electrical interests of Canada demand the formation of a Canadian Electrical Association, to which it would undoubtedly be to the advantage of every man interested in electricity in the Dominion to belong.

THE safety of the electric light as a means of illumination has been well demonstrated during the last year in Philadelphia. In that city the light or power is used in over 5000 buildings. 287 buildings have their own apparatus, ranging from a 20 light to a 4000 light installation; in the aggregate, 80,258 incandescent and 3,325 arc lights. There are also 15 central stations supplying from 2000 to 40,000 lights each, and motors from ⅛ to 30 h. p. Chief Inspector McDevitt of the Fire Underwriters' Association, reports that during the year "no insurance loss occurred in any building in our city from fire where the cause could be in any way attributed to electric wires." This is a splendid showing, and one of considerable encouragement to electric light men. It also demonstrates the wisdom of rigidly enforcing the rules of the insurance companies in the manner of running wires and installing electrical apparatus generally. These rules may at times seem somewhat arbitrary, but the results attained through their observance in the matter of reputation alone, are of as much value to the electrical interests as they are financially to the insurance companies.

THERE is to-day no more important problem to be worked out by the electrical engineer than the invention of a successful method of furnishing current from the generator to the street car motor without the use of overhead wires. The unsightly constructions which are found necessary will not be long tolerated in the principal streets of large cities. The authorities of Berlin have decided that no more permissions be given for this class of work. We are sanguine that the skill which has brought the electric railway to its present state of perfection will solve the problem, and that at a very early date. The action of municipal authorities such as we have mentioned, will no doubt be a spur to action, and if it becomes more general, we may look for more

continued and earnest experiment such as will certainly command success. As we have before pointed out the conditions to be fulfilled by a conduit system are exacting in the extreme, and one reason perhaps that they have not been more successfully grappled with may be, that the growth of the business has been so rapid where overhead construction has been permitted, that little time has been available for experiment. When overhead construction is unattainable, we are confident the conduit will be provided.

THE introduction of electricity in the arts and as a necessity of every-day life, has been the means of giving an immense impetus to the development of power producing mechanism. The ideal power of course is that of falling water, and the facility with which the electric current can be transmitted by metallic conductors has made it possible to utilize some of these natural sources, which otherwise would have been unattainable. The immediate future will, no doubt, see more of this development carried out; but for any considerable distance the heavy cost of wire and loss in transmission make their utilization more expensive than the consumption of coal upon the spot. Various kinds of engines have been devised for the production of power—petroleum engines, gas engines, hot air engines, and so forth. They are, to a certain extent, useful for small powers up to say 10 or 15 h. p., but above that, too expensive and complicated. It is the steam engine that has so far held undisputed sway, and the machines of magnificent proportions that are in use in driving steamships, and in our largest factories and electric works, are examples of what may be accomplished in the way of development when inventive skill and sufficient means go hand-in-hand. But enormous powers have now become such a necessity that, perfect though the steam machine may be, there still remains an enormous margin of profit by the accomplishment of even a small percentage of saving when taken in the aggregate. The far-seeing engineer is even now casting about to see if perchance there is not a new method of evolving motive power from Nature's resources that shall be under sufficient control. A few years back an effort was made to utilize a mixture of bi-sulphite of carbon and petroleum. If the promoters could have utilized the strength of the smell of that mixture, it would have been an immense success, but after poisoning half the town the affair was abandoned as a failure. To look with a prophet's eye into the future, it does seem possible that the enormous power locked up in some of the modern explosives might be tamed and brought sufficiently under control to develop a cheap and useful power. The tremendous energy contained in the gases liberated by the detonation of gun cotton or nitro-glycerine would be capable of doing yeoman work if imprisoned and used expansively in the modern cylinder. It would be ticklish stuff to handle while the experiments were in progress, and might possibly require a continuous supply of inventors before any measurable degree of success was attained, but if it were possible to secure the main bulk of materials against explosion, allowing only the atom required for each stroke to be separated safely and used, the rest would present no more difficulty than is met with in the ordinary gas engine. It might be possible to use reservoirs of unmixed material, each in themselves harmless, but capable of great explosive force when combined only in quantities necessary for use stroke by stroke in the engine. It is just possible that this suggestion of ours may be irreverently received by our engineering readers, and that they may prefer to pin their faith on their old reliable friend, the steam boiler, and say that with all its faults they love it still, and that for their part they decline to change their designation of steam engineer for that of dynamiter; but this is a rapid age in which we live, and we may yet see some such development of power-producing mechanism. What an advantage it would be in the way of portability, for instance, for a locomotive to start out with a pailful of fulminate instead of twenty tons of coal and water, while its possibilities on the ocean would be limitless. He will be a hardy pioneer in the field of invention, however, who undertakes the solution of this enticing problem.

THE question of the desirability of municipalities operating their own electric light plant is one that is just now attracting considerable attention. Extravagent claims have been made in the past of wonderfully cheap lighting, and these claims obtained considerable currency amongst the uninitiated, and were largely quoted by municipal economists until their true nature was shown up. This was done in the able paper read before the National Electric Light Association at its last summer meeting, by Mr. M. J. Francisco, of Burlington, Vt. The paper was the result of careful and thorough investigation of the circumstances surrounding the actual operations of municipal lighting in nearly every case in which the plant was then owned and worked by the municipalty itself. It was found that invariably a certain amount of the cost of operating, and frequently the fuel and supplies, were charged to other departments of civic expenditure, hence the apparently low price at which lights were produced. Perhaps steam to run the dynamo was taken from the waterworks boilers, in which case the extra fuel was ignored and thus made a charge on the water department, and employees whose names appear on the civic pay sheet for entirely different purposes have been told off to perform parts of the work connected with the lighting outfit. By means such as these the advocates of municipal ownership have been able to show wonderful results—on paper; but one or two recent cases of the willingness of municipalities to transfer the lighting plant to private parties have tended somewhat to dispel the illusion. In large cities where political influence is a factor, there is no doubt that a private company can furnish the light cheaper and better than the municipality itself. Level-headed citizens recognize this fact, and there is a tendency to curtail the powers of corporations in the matter of owning and operating industrial enterprises of any description whatever. In smaller towns and villages, the case is somewhat different. There is usually an individual who is a sort of Pooh-Bah of village politics—he is constable, caretaker of public offices, lamplighter, probably sweeps out the village school, and rings the bell; he is pound-keeper, and is vigilant in keeping the geese off the public street. He is expected to fill in his time repairing sidewalks, and probably has to do the digging when any of the forefathers of the hamlet come to be laid in their long, narrow bed. When the patriarchs commence to agitate the electric light question, it is at once considered that as this ubiquitous genius will not have the coal oil lamps to fill and light, his valuable services can be made available to look after the electric lamps, and the old man at the little pumping house down by the creek, who runs the town waterworks from eleven till one every day to fill up the citizens' barrels, can be kept out of mischief by running the dynamo at night. By thus taking the worth of their princely salaries out of the hides of these pampered officials, there is no doubt the community has the advantage by a cent or two per night over the man who would otherwise make a business of supplying electric light. There are quite a few small places in Ontario which adopt this method, and at first sight it would seem to be an argument in favor of municipal control. But follow it out to its logical conclusion and see what it means. If for the sake of saving a few cents the town utilizes its resources to drive out the electric light man who would pay his taxes like a good citizen and consume the storekeeper's supplies, why not save a few more by running out the baker, and have the town clerk in the intervals of his arduous duties bake the town bread, and supply it to the townspeople at cost? It might also be found that the shoemaker or tailor were making a little profit out of what they did for the people, therefore fire them out, and have a municipal shoemaker or tailor who might, when not otherwise employed, make himself generally useful by keeping the cows off the grass or pumping the requisite quantity of water into the town milk-pail. If the principle were followed out, as we said before, the town would degenerate into a commune, or a simple co-operative society of a few families where profits of any kind were unknown, and business enterprise entirely knocked on the head. The idea of these municipalities is (and there is one not a thousand miles from Toronto to-day figuring the same way) to do a commercial business with public resources, and it can have only one ending, and that is to drive away legitimate business enterprise and investment which might bring grist to the municipal mill. Some towns go to the other extreme, and will bonus a new enterprise, which is just as great a mistake in the other direction. If a business has any vitality, it will thrive without this pampering, but it is worse than folly for any community to kill off a new enterprise like the introduction of electric light and its concomitant industries by competition fostered by the expenditure of public monies, often at a loss to the municipality interested.

A LETTER FROM THE PACIFIC COAST.

KAMLOOPS, B. C., Feb. 21st, 1891.

Editor ELECTRICAL NEWS.

DEAR SIR,—I lately authorized my book-keeper to forward you one dollar, for subscription to the ELECTRICAL NEWS, and hope to hear that you received it. Please accept my most sincere felicitations for getting out a paper which I am sure will be very useful to the electrical fraternity. I have already derived benefit from it, for which please accept my thanks. I formed a stock company here on the 11th of this month ; everything is going on very satisfactorily. Wishing you every success, I remain,

Yours truly,

J. E. SAUCIER.

CANDLE POWER OF ARC LAMPS.

SOUTHAMPTON, Ont., March 24th, 1891

Editor ELECTRICAL NEWS.

DEAR SIR,—Would you kindly inform us either by letter or through the columns of your paper the amount of power that experts claim that each arc lamp will take on a 25 light machine, 1,000 candle power lamps on a two mile circuit, and oblige,

Yours truly,

BOWMAN & ZINKAN.

[The candle power of the arc lamp is a variable quantity according to the fancy of manufacturers. The usual standard of current for what is known as a 2,000 c. p. lamp is ten amperes, and therefore a 5 ampere current is considered about the thing for 1,000 c. p. For the 2,000 c. p. lamp about seven-tenths of a horse power is required to be delivered at the dynamo, and for a 1,000 c. p. four-tenths. A two mile circuit of wire such as is usually run, sav No. 8 B. & S. gauge for the 1,000 c. p., would absorb about as much energy as one lamp.—ED. ELECTRICAL NEWS.]

RENFREW, March 11th, 1891.

Editor ELECTRICAL NEWS.

SIR,—Enclosed you will find an interesting slip which I cut from one of our local papers, and which is doubtless going the rounds of the press.

' The Mayor of Marquette, Mich., reports that their electric light and water plant has netted the city $4,000 per year, and that in a very short while he hopes to run the city without any other tax than that received as profits from the users of water and electricity."

This is likely to do no little harm to electric light men, as it no doubt gives only half the truth. Have you any means of gaining reliable information in this particular case, so that the facts as they actually exist can be given ?

Doubtless you will remember that the advocates of municipal lighting received a thorough exposition at the hands of Mr. Francisco in a very able paper read by him last August at the meeting of the National Electric Light Association at Cape May. Marquette had evidently not taken such a prominent position at that time in coining money for its inhabitants as it has of late, since he did not mention this progressive town in his valuable paper.

Should you become possessed of any *facts* in this particular case, please let your readers have them through your columns. Will merely add that I am thoroughly in accord with the idea of forming a *Provincial* E. L. Association, and will be glad to forward my membership fee at any time.

A. A. WRIGHT.

ANNUAL DINNER OF HAMILTON NO. 2 C. A. S. E.

March 27th, 1891.

Editor ELECTRICAL NEWS.

DEAR SIR,—The fourth annual dinner of Hamilton No. 2 C. A. S. E., was celebrated on the evening of March 26th at the Dominion Hotel. President R. Mackie occupied the chair, and Vice-President Potter supported him in the capacity of vice-chairman. The members of No. 2 have always spent a pleasant time at their annual gathering, and this year was certainly no exception to the rule. After justice had been done to the good things (and there was an abundance of them), President Mackie addressed the meeting with a few appropriate remarks.

Letters of regret were read from His Worship the Mayor, who was confined to bed by illness, and Mr. Gibson, M.P.P., who was unavoidably absent.

The toast of the Queen and Royal Family was loyally responded to by the singing of the National Anthem.

The next toast was "The Dominion of Canada and Her Legislature," which was responded to by Mr. Ryckman, M.P., in a capital speech, in which he highly eulogized the aims and objects of the Canadian Association of Stationary Engineers, and assured those present that they could always count on his help in the Legislature to assist in passing any fair measure which would have a tendency to raise the status of the stationary engineers, and at the same time make the steam boilers of Canada a source of less danger to the general public.

Next in order came the toast of "The Local Legislature," which, in the absence of Mr. Gibson, was responded to by Mr. Bell in a very happy speech, in which he alluded to the fact that at one time he had been a candidate for Legislative honors, but, unfortunately (for the country), when it came to counting the votes, the other fellow appeared to have the best of it. He paid a high compliment to the Ontario Government, and said that he had watched business in the Local Legislature very closely, and he was sure that when any measure came up that was to the best interests of the Province of Ontario, the majority of the gentlemen on both sides of the House, irrespective of politics. had always proved themselves worthy of the confidence placed in them by the electors.

The toast of "The Mayor and Corporation of the City of Hamilton" was ably responded to by Ald. Dixon. During the course of his speech he took occasion to mention the fact that there would in all probability be several new enterprises started in Hamilton during the present year ; also that the City Council were doing their best to get the C. P. R. into Hamilton, and he was of the opinion that the object would be accomplished in the near future. He made some very complimentary remarks on the principles, aims and objects of the C. A. S. E. and the methods used in endeavoring to secure the same, and expressed himself as being strongly in favor of an Engineers' License Law, which he firmly believed would be passed by the Local Legislature now in session.

"The Manufacturers" was responded to in suitable terms by Mr. Dewry.

"The Executive Board of the C. A. S. E." was responded to by President Wickens of that body, who outlined the history of the Association and explained its chief aims and objects. He also proved to the satisfaction of all present that the duties of the stationary engineer of the present day were far more exacting than they were a few years ago, owing to the introduction of higher steam pressures and higher grade of complicated steam engines, such as the compound, triple expansion, automatic cut-offs, and the general adoption of electricity for generating light and power in connection with our manufacturing interests. A few years ago all an engineer was asked to do was to shovel coal and sling oil ; but now the manufacturers are beginning to find out that a little extra outlay in a year to secure the services of a competent engineer, is a good investment, and a source of much comfort. Mr. Wickens explained the chief object of the C. A. S. E. to be to educate engineers, and thus fit them to fill positions with credit to themselves and with profit to their employers. In doing this the Association invite their employers to become honorary members, attend the meetings and see for themselves that the Association is working on proper lines. He felt satisfied if the manufacturers of Canada would do this, they would (in justice to themselves) join hands and help the good cause along.

The next toast on the list was "Toronto, No. 1 Association," which was responded to by President A. E. Edkins, who thanked the gentlemen present for the hearty manner in which they had received the toast. During the course of his remarks he made mention of the proposed amalgamation of the C. A. S. E. and the N. A. S. E. of America. He expressed himself personally as not being in favor of the proposed union, and advocated remaining as a Canadian organization. He said that he was aware be was treading on dangerous ground, as he was informed that Hamilton No. 2 was unanimously in favor of amalgamation, and hoped that whatever might be done in this matter would prove to be in the best interests of the Association.

The toast of "Brantford, No. 3, and London, No. 5," was duly honored, but, unfortunately, there was no one present to respond.

At this stage, Mr. Ryckman proposed the toast of "Hamilton, No. 2," which was replied to by President Mackie in suitable terms.

The meeting broke up after singing "Auld Lang Syne" and

"God Save the Queen," everyone expressing themselves as having spent a most enjoyable evening.

During the evening the proceedings were enlivened by some excellent songs by Mr. D. Robertson, Mr. Bowes, Mr. Bell, Mr. McDonald, Mr. R. Mackie, and a laughable recitation by Mr. Chapman.

Yours truly,

"SAFETY."

THE MECHANICAL PRINCIPLES OF WORK.

THE first of what is expected will be a series of very interesting lectures was given by Mr. John Galt, C. E., on Friday evening, March 27th, in the rooms of the Inventors' and Patentees' Association, Public Library Building, Toronto. The subjects treated of were the mechanical principles of work, and the expansion of steam. Mr. A. E. Edkins, President of the Society of Stationary Engineers, under whose auspices the lecture was held, occupied the chair. The meeting was largely attended.

Mr. Galt said it was a source of great pleasure to see an audience composed of practical men take so manifest an interest in something that was not intended to be a formal lecture, but a simple talk on scientific matters. The large audience present was sufficient to show the need of institutions for practical training, for evening schools to impart scientific knowledge which would be useful in the various trades. There were certain sciences that bore more directly upon each branch of trade, and the knowledge of them enabled a man to rise higher than a mere hewer of wood and drawer of water. To supply this want was recognized as an important part of the educational systems of England and the United States. Large sums were spent annually to give scientific instruction. When a boy left the public school he was merely on the threshhold of knowledge. There was an aching void between the public school and the University. The ordinary student could not step from one to the other. What was needed to supply the pressing want of the day was the missing link between the public schools and the University. He supposed all were aware that an agitation in this direction had long been going on in Toronto. It was pleasing to know that at last there was a prospect of obtaining the much needed workingmen's technical school. This was important from a national as well as a local standpoint. What the working classes wanted was a fair share of the public moneys spent on their behalf. They had only to make the demand, and it must be recognized.

Passing on to the subject of the evening, Mr. Galt said he did not intend to read a sermon. He proposed to give a practical talk upon the principles of mechanics as applied to work. To the mind work suggested something that was moving, therefore work was synonamous with motion. Work was active, not passive. A wall might support a great weight, and was an evidence of force without motion. Work was force in motion; to analyze force was a very difficult thing. Matter was endowed with this inherent principle. What causes motion must be defined as force. As in all sciences, it was here necessary that force should be reduced to some form of measurement. Every science had some typical instrument for measuring purposes. Astronomy had the divided circle. Chemistry had the balance. Heat was determined by the thermometer. So, also, the whole system of mechanical principles of work might be symbolized by a foot rule, set of weights and a clock. The rule determined distances, the weights gave the pressure, and the clock measured the time. One of these units of measurement did not mean anything. If he held up his hand and said "one" it would mean nothing; if he said "one pound," thereby combining two of the units of measurement, he at the same time gave a notion of work. All quantities in mechanics might be expressed in terms of units derived from the fundamental units of length, mass and time. The unit for length was one foot, the unit for mass was one pound, and the unit for time was one minute. From these three fundamental units were deduced the gallon measure and the cubic foot. Work is measured by the product of the existing force and the distance through which it is overcome. Whenever there was motion there must be something to produce it. The simplest conception of work is lifting against the force of gravity. The standard of work was the lifting of a pound weight one foot high. The question of time did not enter into this, but was connected with the question of power or the rate of doing work. Foot pound being the standard of work, all calculations were made upon that basis. Thus to raise ten pounds two feet, was equal to raising twenty pounds one foot. Work done in this way was overcoming the attraction of the earth at that point. Work was also done when two magnets were drawn asunder, or when a spring or electric cord was drawn out. Work being simply force in motion, it was only necessary to multiply the weight in pounds with the distance in feet traversed to get the work done.

The next point was to distinguish between work and power. The introduction of the unit of time into the calculation enables the scientist to calculate the power of a force. The term "power" meant the rate of doing work. It was very important to fully understand this definition. Take any quantity of work that was done in one minute, and if the same quantity were done in two minutes, the time of doing it being double, it would only require half the power to do it. Rate of work, therefore, was quantity performed in some given interval of time. The standard of power which had been generally adopted was called horse power. One horse power consisted in lifting 33,000 pounds one foot in one minute, or 1,980,000 foot pounds per hour. It never was supposed to be able to do one-tenth of this amount of work. From a swift footed race horse to a heavy draft, the product of their speed into the resistance overcome is a measurable quantity representing 33,000 foot pounds per minute. By means of a lever man could often best exert his power, but as the old proverb went, "What was gained in power was lost in speed." To gain power meant that it was possible to move a heavy weight by a small force, provided one loses time by doing it very slowly. This was illustrated by the mechanical principle of the wheel and axle, also by the reduplication of pulleys as found in pulley blocks. Where by any contrivance a man moved a great weight by a small force, the difference between the weight and the force was compensated for by the loss of time. It was impossible to increase power. No matter what mechanism was resorted to, there would be a loss of time in proportion to the power gained. If this simple fundamental principle were well known, much loss of inventive energy might be avoided. The doctrine of the conservation of energy was not very well understood; if it were there would be fewer attempts to invent perpetual motion, or to devise means for increasing power. The conservation of energy was as well demonstrated as the indestructibility of matter. The all-wise Creator had endowed all matter with energy, and it could never be destroyed. The energy which was utilized in the water fall was the same energy which propelled the steam engine.

Passing on to the expansion of steam, the speaker explained the theory of expansion in the cylinder according to the parabolic curve. The power of an engine was calculated by the average pressure multiplied by the number of inches which gave the foot pounds, and this was multiplied by the feet travelled by the piston in a minute. From this the horse power was obtained, as already explained.

At the conclusion a hearty vote of thanks was tendered to Mr. Galt, Mr. Edward Meek and Dr. Wm. Fall speaking very highly of the lecture. They expressed the hope that there would be other lectures and that they would be equally successful.

Since delivering his lecture, Mr. Galt has received the following letter of enquiry, the reply to which is appended:

219 CHURCH ST., TORONTO, March 28, 1891.

SIR,—Re H. P. of steam engine, I am the party who raised the question of rate of speed of horse. A H. P. is defined as a power that can lift or raise 33,000 lbs. 1 ft. high in one minute, but the same horse power may lift 40,000 lbs. the same height in the same time exerting less power. Then it becomes necessary to limit or define the rate of speed of horse. If the rate of speed of horse is not taken into account, why take speed of engine into account? You cannot compare superficial ft. with cubic ft. If the three units of the one are taken, the same units of the other must of necessity be taken in order to compare them. Watt defines a H. P. as a power that could lift 33,000 lbs. 1 ft. in one minute travelling at the rate of 220 ft. per minute, which is the rate of travel in estimates of horses on public works, *i. e.*, railroads, canals, etc.

With due respect I write this, so that if possible that I may make myself clearly understood.

Yours truly,

D. A. ROSS,

C. & M. E.

TORONTO, ONT., 30th March, 1891.

D. A. ROSS, ESQ., City.

SIR,—You are still in error, friend, and likely to remain so until you fully and clearly comprehend that the standard horse power is the rate of doing work equal to 33,000 ft. lbs. per minute. Any force moving any distance in overcoming resistance and producing motion, the product of which for one minute will give 33,000 units of work, must be taken to equal and represent a standard horse power. If 40,000 lbs. is to be raised by a horse power, it must be done at the rate of .825 of a ft. per minute, for $\frac{40,000 \times .825}{33,000} = 1$ H.P.

Your contention as to the usual rate of speed by canal horses may for argument's sake be taken as correct, but your deduction is wrong, because $33,000 \div 220 = 150$, as representing the force exerted by horse so as to give in one minute of time the proper standard, viz., 220 ft. $\times$ 150 lbs. = 33,000 ft. lbs. = one horse power. Notice that the speed of horse has everything to do with the force exerted, but nothing whatever to do with the result. Greater speed $\times$ lever force = slower speed $\times$ greater force = constant quantity of work in given time = 33,000 ft. lbs. per minute = 1 horse power.

The speed of the horse, therefore, is only one element in the calculation. The speed assumed, however, is a very good example in practice, viz., 220 ft. per minute, or 2½ miles per hour.

I hope these simple explanations will put my friend right.

Yours truly,

J. GALT.

Prof. Silvanus Thompson says of Mitis metal in his recent lectures on "Magnets," that he has found it far superior to ordinary cast iron, and not much inferior to wrought iron, for electro-magnets. It is well known that the field magnets of dynamos and motors are made to certain forms, mainly to avoid expensive forgings on the one hand or inferior results with cast iron on the other. In most cases a compromise is made by using good wrought iron for the straight cores and cast iron for the pole pieces, the latter involving difficult work, if forged out of wrought iron.

Experiments were recently made by the Manchester Steam Users' Association to determine the effect of showering cold feed-water on red-hot furnace crowns. The boiler used for the purpose was of the Lancashire type, with plane furnace flues and single-rivetted lap joints not strengthened by flanged seams or encircling ring. It was found that the introduction of the cold feed did not lead to an explosion, even when the crown sheet was red-hot; but that, on the contrary, it was often followed by an actual *diminution* in steam pressure. The *Locomotive*, referring to the test, says: We should not recommend the introduction of cold feed-water at such a time, however, because it is likely that the consequent sudden chilling of the plates might, under some circumstances, produce strains in the shell that would hasten the failure of the crown-sheet, or of some of the tubes, so that the attendant might be scalded.

CALCULATING SIZES OF WIRES.*

[*Continued from March Number.*]

SAFE CARRYING CAPACITY.

The National Board of Fire Underwriters specifies that the carrying capacity of a conductor is safe when the wire will conduct a certain current without becoming painfully warm when grasped by the closed hand.

All wires will heat when a current of electricity passes through them. The loss of energy which was referred to in a previous chapter is a loss only in the sense that it is lost for *useful* work.

Nothing is lost in nature; electrical energy may be transformed into heat, light, motion, etc., but energy cannot be lost. This so-called lost energy in the wires will therefore re-appear as heat, although not wanted in the wire.

The greater the current in amperes and the smaller the wire, the greater the heating effect.

Larger wires will be heated comparatively more than smaller wires, as the latter have comparatively more radiating surface.

It is approximately true that the heat increases directly as the square of the current, and inversely as the cube of the diameter of the wire. This statement may be written thus:

Heating effect $= \frac{c_2}{d_3}$ where c is the current and d the diameter of the wire.

In Table 1 are given the carrying capacities in amperes, and lamps of different sizes of wire. A wire is here assumed to have a safe carrying capacity, when its temperature is not increased over 30° F. above that of the surrounding air, when conducting current. In many tables a much higher temperature is adopted as a standard. It is safe to fix upon 30° F. as a maximum, however, as many circumstances, such as may be found in hot engine rooms, proximity to steam pipes, in twists or sharp bends in the wire, may cause a considerably higher rise of temperature than anticipated. The following empirical formula is used for calculating the carrying capacity:

$c = \sqrt{\frac{d^3}{2500}}$ for an increase of 30° F. in temperature, where c stands for current, d for diameter in mils, and 2,500 is a constant.

Rule X. Ascertain the proper size of wire for permissable loss, number of lamps and distance. Then determine by Table 1 whether the wire has the necessary carrying capacity. If not, assume smaller percentages of loss, until a wire is found that will be large enough to carry the current safely.

It may tend to make certain phenomena more easily understood to state that the electric current passing through a wire is

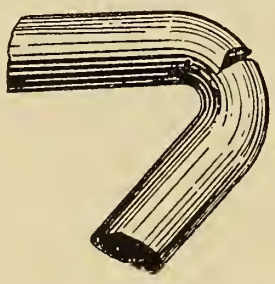


Fig. 9.—Sharp Bend in a Wire.

frequently compared to water flowing through a pipe. Prof. Ayrton says in "Practical Electricity," this analogy, however, like many other analogies, must not be strained too much; for example, a bend in the pipe, even with the steady flow of water, is found to cause a falling off in the water pressure; whereas, a bend in a wire has no effect on the electric potential if a steady current is flowing; or, again, if there be a sudden expansion or contraction in a pipe, there is a sudden alteration of the water pressure, which has no analogy in any sudden alteration of the electrical potential at a point in a circuit where the sectional area of the conductor changes abruptly. In fact, the flow of water or of gas in a pipe can be diminished to any extent by a contraction of one point *only*, which may be practically effected by partially closing a tap or cock; whereas, if an electric circuit consist of many yards of wire, no appreciable alteration of the current will be produced by making only half an inch of the wire, say one-tenth of its previous sectional area. The carrying capacity of any part of a wire, however, is materially reduced by making it of a smaller cross-section, and such a reduction in sectional area may cause a considerable heating of that portion of the wire.

A sharp bend in a wire is therefore only dangerous, as it reduces the sectional area, and not because it introduces a resistance.

Fig. 9 explains how a sharp bend may cause a wire to be partially torn asunder, and thus decrease the sectional area and cause undue heating at this point.

It may be stated as a general rule, that when a large percentage of loss is allowed with lamps at short distances, the size of wire calculated simply in accordance with resistance rules will be found too small to carry the current safely.

This simple fact is often overlooked, and even though wires may have been correctly calculated for a uniform percentage of loss, they will become painfully hot simply because the table of carrying capacity was not consulted.

The cross-connection of mains wherever possible, as already recommended, for the purpose of maintaining equal potentials, will also often reduce the heating effects of the current. A case

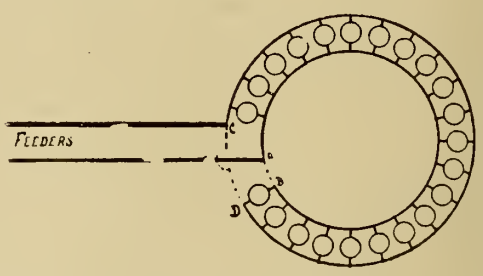


Fig. 10.—Faulty Loop Circuit.

came under the author's observation which will well illustrate this fact. A circle of about 50 lights was wired, Fig. 10. After the current had been turned on the wires of the circuit became hot, and there was quite a perceptible difference of candle power between the lights near A and those near B. Investigation disclosed the fact that the loop, contrary to instructions, had been left open. A few inches of wire connecting A and B and C and D remedied the fault; the wires remained cool and the candle power was practically the same all round the circle.

The smallest wire used for incandescent wiring should be at least of 250 circular mils of cross-section. Smaller wire will break too easily when handled, and thus cause endless trouble.

THE THREE-WIRE SYSTEM.

The foregoing remarks which treat of "Drop of Potential" and "Safe Carrying Capacity," have reference only to conditions met with in a multiple arc system of distribution.

It has been briefly explained that in the three-wire system the electromotive force is double and the current is one-half that required for the same number of lamps on the multiple arc system.

All the rules previously given may readily be applied to the three-wire system.

Let us again compare these two systems.

Example: Find the electrical data for four lamps of 100 volts and 200 ohms' resistance each for both systems.

Demonstration: The current for one lamp according to Ohm's law $= \frac{1}{200} = \frac{1}{2}$ ampere.

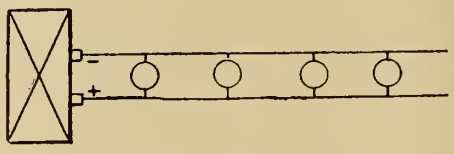


Fig. 11.—Multiple Arc System.

a. Multiple Arc System. (Fig. 11.) Joint resistance $= \frac{200}{4}$ $= 50$ ohms; total electromotive force $= 100$ volts; total current $=$

$\frac{1}{2} \times 4 = 2$ amperes or $\frac{\text{electromotive force}}{\text{total resistance.}} = \frac{100}{50} = 2$ ampéres.

b. Three-Wire System. (Fig. 12.) The joint resistance may easily be found by omitting from the calculation the third or neutral wire. We will then have two series of two lamps each. The resistance of two lamps joined in series will be of course twice that of one lamp, or 400 ohms.

The joint resistance of two series will therefore be $\frac{400}{2} =$

* From "Incandescent Wiring Hand-Book."

200 ohms ; or in other words the joint resistance of the lamps in the three-wire system will be four times the joint resistance of the same number of lamps in multiple arc.

The total electromotive force in the three-wire system of course will be twice that of the electromotive force in the multiple arc system.

Again, the total current will equal $\frac{\text{total electromotive force}}{\text{total resistance}}$ or, $C = \frac{2 \cdot 0}{20} = 1$ ampere, or in other words, the total current required for the lamps in the three-wire system, will be ½ of the

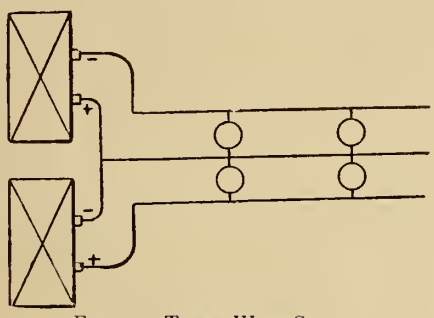


FIG. 12.—THREE-WIRE SYSTEM.

total current required for the same number of lamps in the multiple arc system.

With this demonstration in mind we are ready to form

Rule XI. For the same kind and same number of lamps the joint resistance of the lamps in the three-wire system is four times that of the multiple system ; the total electromotive force of the lamps in the three-wire system is twice that of the multiple arc system, and the total current strength of the lamps in the three-wire system is one-half the corresponding unit in the multiple arc system.

It can easily be seen that as the joint resistance of the lamps is four times greater in the three-wire system than in the multiple arc system, the resistance of the positive and negative conductors will be four times greater for the same percentage of loss. In other words, the cross-section of the wires in the three-wire system is ¼ that of the wires in the multiple arc system for the same percentage of loss. This gives us :

Rule XII. In order to find the proper size of wire for the three-wire system, first find the size of wire for the same number and kind of lamps on the multiple system in accordance with Rules VI and VII, then divide the number of circular mils by four.

The sum of the lengths of the positive and negative wires is the entire length of the circuit in the three-wire system, and the amount of copper required for the circuit is equal to one-fourth the amount of copper required in a multiple arc circuit ; the length of the central or neutral wire, if of the same size as the positive and negative leads will be only one-half the length of the total circuit ; hence the total amount of copper in the three-wire system will be ¼ + ⅛ = ⅜ of the amount necessary in the case of the multiple system.

As a matter of fact the neutral wire may be made smaller than the positive and negative wires, as it seldom will be called upon to carry more than a fraction of the maximum current. For practical reasons, however, it is advisable to make all three wires of the same size.

It will be seen that as the number of circular mils per wire in the three-wire system is ¼ the cross-section per wire in the multiple system, the carrying capacity in amperes of course is also reduced to ¼.

When Table 1 for the three-wire system is used it should be borne in mind that *only twice* the number of lamps may be carried by the wires, as the current is reduced to ½ for the same number of lamps.

The three-wire system in a building is generally followed throughout the whole network of feeders, mains, branches and sub-branches, down to circuits of from three to six lights ; smaller numbers would then be connected in simple multiple arc.

EXPLANATION OF TABLES.

Wiring Tables 3, 4 and 5 may be used by any one who does not care to study the principles underlying the calculations of the sizes of wires ; but even to those who thoroughly understand the demonstrations, the tables will be found of great convenience.

The first thing to do is to select the table for the lamps which are to be used. Let us consult the table for data relating to the 100 volt lamps.

We find in the horizontal columns at the top and bottom, numbers which correspond to "lamp-feet." (Lamp-feet is a brief expression used to denote the product obtained by multiplying the number of lamps by the distance in feet.) At the left of the table we find three vertical columns filled with figures representing circular mils ; and also underlined figures giving the numbers of the Brown & Sharp gauge. Each horizontal column corresponds to a vertical column.

The radial lines starting near the left hand corner represent percentages of loss. Each small space in the inside columns represents 2000, in the middle columns 500, and in the outside columns 125; that is to say in the horizontal columns the numbers represent lamp feet ; in the vertical columns the numbers represent circular mils, except where underscored, when they represent the number of the wire according to Browne & Sharp gauge.

Although the difference would be very slight in any case, it is necessary to note, for those who may desire absolute accuracy in determining the circular mils, that the short heavy lines beneath the Browne & Sharpe gauge figures in the vertical column, are the correct gauge lines and may be understood as extending the full width of the table.

The figures given in the columns represent thousands. For instance, 100 denotes 100,000 ; 4.25 = 4250 ; 2.5 = 2500, etc.

Example : Find the size of wire for 100 110 volt lamps at 1000 feet distance, at 10 per cent. loss.

Demonstration : 100 × 1000 = 100,000 lamp-feet. We find 100 in the *inside* horizontal column ; we follow the vertical 100 line until it intersects the 10 per cent. line. We take a ruler and lay it horizontally through this point and find it strikes about 88 in the *inside* vertical column. The proper size of wire has a sectional area of 88,000 circular mils. If we wish to wire on 5 per cent. loss we follow the vertical 100 line until it intersects with the 5 per cent. line and obtain by laying a horizontal line through this point about 186,000 circular mils.

From this demonstration we deduct the following general rule for computing from wire tables :

Rule XIII. Find the number of lamp-feet (lamp × feet), in one of the horizontal columns, follow the vertical line until it intersects the desired percentage line. A horizontal line laid through this point will show in the corresponding vertical column the cross-section of the wire in circular mils.

In consulting the table, always use corresponding columns. If the lamp-feet are found in the middle column, the circular mils must be read from the middle column ; if the lamp-feet are found in the outside column, the circular mils must be read from the outside column, etc.

Example : Find the size of wire for 20 110 volt lamps, at 900 feet distance at 5 per cent. loss.

Demonstration : 20 × 900 = 18,000. We find 18 in the *middle* horizontal column ; we follow the vertical 18 line until it intersects with the 5 per cent. line, and following the horizontal line we find in the middle column 33,500 circular mils.

Example : Find the size of wire for 50 110 volt lamps at 100 feet distance at 5 per cent. loss.

Demonstration : 50 × 100 = 5,000 lamp-feet. We find 5 in the middle lower column, and a glance shows us that the wire is over 9,300 circular mils or a little larger than No. 11 B. & S. gauge. We can find the same result by taking 5,000 in the outside horizontal column.

Rule XIV. The number of lamp-feet within moderate numbers can always be found in one of the three horizontal columns. Select the one which will intersect with the desired percentage line farthest from the left lower corner. If the number of lamp-feet is too great, and cannot be found in the table, divide it by 10 and find the circular mils for one-tenth the number of lamp-feet first, and then multiply the result by 10.

Example : Find the size of wire for 1,000 110 volt lamps, 1,000 feet distance at 10 per cent. loss.

Demonstration : 1,000 × 1,000 = 1,000,000 lamp-feet. Divide by 10 = 100,000 lamp-feet. Size of wire for 100,000 lamp-feet = 88,000 circular mils, for 10 × 100,000 = 1,000,000 lamp-feet = 10 × 88,000 = 880,000 circular mils.

The 55 and 75 volt tables, of course, are to be used in the same manner as explained in the case of the 110 volt table.

It will be noticed that the small spaces in the three *vertical*

columns of all three tables represent the same values while the values in the *horizontal* columns of the three tables differ as follows :

Number of Lamp-feet per Small Space.	Tables.		
	55 Volt.	75 Volt.	110 Volt.
Inside Horizontal Column.....	500	1000	2000
Middle Horizontal Column.....	125	250	500
Outside Horizontal Column....	31.25	62.5	125

The tables are very simple, and will become familiar to the user after a short practical experience.

The 55 volt table may be used for lamps of a voltage between 50 and 60 volts, the 75 volt table for lamps of a voltage between 70 and 80 volts, and the 110 volt table for lamps of a voltage between 100 and 115 volts. The results will be accurate enough for all practical purposes.

In calculating the tables, lamps requiring 55 watts were assumed. The following table gives the electrical data of such lamps :

16 CANDLE-POWER LAMP REQUIRING 55 WATTS.

Electromotive Force in Volts.	Current in Amperes.	Resistance hot in Ohms.
110	.50	220
75	.7338	102.207
55	1.00	55

Under Rule VII it was shown that Rule VI could be simplified by calculating the constants for each kind of lamp and each percentage of loss. In the following table are given the constants for 55 watt lamps at different percentages of loss in the conductors.

TABLE OF CONSTANTS.

	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	12½	15%
55 Volt Lamp.	38.8	19.2	12.7	9.4	7.5	6.1	5.2	4.5	4.0	3.6	2.7	2.2
75 Volt Lamp.	20.9	10.3	6.8	5.1	4.0	3.3	2.8	2.4	2.1	1.9	1.5	1.2
110 Volt Lamp.	9.7	4.8	3.2	2.4	1.86	1.5	1.3	1.1	.99	.88	.66	.56

The wiring formula, Rule VI, can now be written $d^2 = N \times D \times K$, or, the size of wire in circular mils = lamp-feet multiplied by constant. The constant K is found from the formula :

$$K = \frac{21.58}{r \text{ hot}} \times \frac{100 - \%}{\%}$$

From the foregoing it will be very easy to find the constant for any lamp and any percentage of loss, and calculate the size of wire without the aid of any tables whatever.

THE BOILER EXPLOSION AT QUEBEC.

THE boiler explosion at the Riverside Worsted Factory, which happened on the 12th February, was the most disastrous which ever occurred in Canada, both as regards loss of life and destruction of property. Our readers will no doubt be interested in some of the facts regarding this very serious occurrence. The engineer who had charge of the steam plant was among the killed, and if carelessness on his part was the real cause, he has paid his share of the penalty. The second engineer stated that he had nothing to do with the boilers and was employed only in the engine room.

There were three steam boilers of the type so commonly used in Canada, and known as horizontal tubular boilers. These were 6 feet in diameter and 16 feet long, with about 84 tubes in each, the tubes being 4 inches in diameter. Each boiler had a dome 30 inches diameter and 30 inches high, and rivetted to the boiler shell by a double rivetted joint. The boiler plates were said to be of good boiler plate iron, three-eighths of an inch thick, and the logitudinal seams double rivetted. The boilers were built in brickwork with Jarvis furnace setting. Each boiler had a safety valve, loaded by lever and weight and intended to open at about 80 pounds pressure. There were also shut-off valves by which the outlet to the steam pipe might be shut, and each boiler had a steam gauge and glass water gauge and try cocks.

The mill had not been running for some days, it having been closed to permit of some changes and repairs to the engine. On the morning of the day of the explosion, steam was got up intending to start the mill, but on trying the engine it was found there was something wrong and it would not go, and while a number of men were engaged on the engine, the explosion took place. The middle boiler exploded, being literally blown to pieces ; the other two were thrown out of their seats, the one to the right and the other to the left, and were each broken into several pieces. The dome of the exploded boiler was torn off, leaving the flange rivetted to the plate of the shell. The body of the dome was thrown to a considerable distance. Such were the facts connected with the disaster, and it is important to notice that steam was up in all the boilers, and that none had been used except what was required for the heating apparatus.

A coroner's inquest was held, and after a very lengthy enquiry and the examination of many witnesses and of the remains of the exploded boiler, the following verdict was returned: "That the said Arthur Tweedell and others were killed by the explosion of the centre boiler of the Quebec Worsted Company's mill, the said explosion being due to an over-pressure of steam in the said boiler, caused by the stop valve being then closed. Furthermore, that the jurors recommend the appointment, as in other places, of a competent city and district boiler inspector, one who has both theoretical and practical knowledge, and who has had experience in the manufacturing of both boilers and engines and all the connections thereof."

The verdict says the boiler exploded because of over-pressure "caused by the stop valve being then closed." But what of the safety valve? It was there for the very purpose of preventing over-pressure, either when the stop valve was closed or open.

The jury *said* nothing about the safety valve, but they saw it. And when they saw it, they saw that before the explosion took place it had ceased to be a safety valve, and its condition really made the explosion possible. The probability is that the steam gauge had been frozen while the mill was closed, as there had been some very cold weather during these days. These boilers were under the inspection of the Quebec Provincial Inspector who was examined at the inquest. His qualifications may be guessed at by the wording of the jury's recommendation. He had no experience or special training to qualify him for the position, but after working in a boiler shop for a few weeks when a boy, had worked at a variety of businesses, such as carpenter, butcher, ship chandler, traveller for sale of boots and shoes, jewellry, &c. How these various occupations qualified him to inspect boilers may be judged from the fact that he did not discover the condition of the safety valve and other fittings on this exploded boiler.

If ever there is to be cumpulsory inspection of steam boilers, let this example be a warning. The government that will attempt to make boiler inspectors part of the political machine, and appoint as inspectors, men who are expert politicians, deserves to have its own safety valve rusted up and a good fire kept going till it gets blown so high that the scattered fragments will be forever lost. Had there been competent inspection and ordinary prudence, this terrible disaster would not have occurred.

To all engineers and firemen the lesson is : *make sure* for yourselves that whenever you put a fire under a boiler there is plenty of water in it, and way for the steam to get out. This boiler exploded simply because there was no outlet for the steam, and the probability is that there was a pressure of not less than 300 pounds in it when it exploded. It would hold about eight tons of water, and the explosion would not be much less than that of a ton of gunpowder, so that there need not be much surprise at the serious destruction of property.

The President of the Bell Telephone Company, of Montreal, recently inquired of the Secretary of the Treasury at Washington whether the end of the telephone cable to be passed through the tunnel connecting Sarnia with Port Huron, Mich., will be permitted to enter free of duty. Assistant Secretary Spaulding has informed him that so much of said cable as may be brought within the limits of the United States will be subject to duty under exlsting laws, the Department having no authority to waive the same.

An exchange points to the fact that the possibility of electricity being used as the motive power for railroads in the feature is assuming an interesting condition. Stations may be located some forty or fifty miles apart, which will be run by large engines, and from recent tests it is found that an electric motor will mount a grade of more than fifty per cent. Not only on railroads, but on ocean steamets will a new era be inaugurated when electricity is introduced. The advantages being a saving of expense, higher rate of speed, and the danger of accidents decreased.

PUBLICATIONS.

Prof. Silvanus Thomson's series of lectures on "The Electromagnet," delivered in February, 1890, before the Society of Arts, London, have been reprinted in book form by the W. J. Johnston Co., N. Y., to whom we are indebted for a copy.

The April issue of *The Arena* is at once rich in variety and strong in its presentation of great fundamental problems, which are agitating the popular mind at the present time. No magazine of the present age is in such perfect touch with progressive and reformative thought as this review.

We are in receipt of a copy of *The Electrician* Electrical Trades Directory and Hand-Book for 1891. The book shows an increase of 100 pages as compared with last year, and contains a vast amount of carefully compiled information relating to the electrical industries throughout the world. Among the many features of interest to the electrical and allied professions are a Digest of the Law of electric lighting; a list of central stations in the United Kingdom for the distribution of electricity; a list of electrical railways and tramways; a summary of the leading events of the past year; a complete list of the local authorities of England; information relating to the obtaining of letters patent; and a reliable biographical section, containing interesting sketches of the careers of the leading living electrical notabilities. Price 5 shillings (postage extra). *The Electrician* Publishing Co., 1, 2 and 3 Salisbury Court, Fleet street, London, E. C.

ENGINE FOUNDATIONS.

THE question of brick versus stone foundations for engines is being discussed. The advantages of brick foundations are given by one correspondent in citing a case. The foundations were of hard-burned vitrified brick, laid in Portland cement. The gentleman in charge of the work stated that stone, unless dressed with extreme nicety, never gets a perfect bearing on its bed, as perpendicular joints can very seldom be filled solid, hence stone foundations, no matter how heavy, are full of vacant spaces that allow vibration. On the other hand, with brick a perfect joint can always be made, thus obtaining a foundation practically one immense block, all of which has to be shaken before vibration can occur.

A few days later, in conversation with a well-known mechanical engineer, I was given another explanation of the matter. This gentleman stated that in such structures all the vibration has its origin in the machine, which is the centre of the foundation, and being at the top is at the most distant point from the earth. Vibration loses much of its force in passing from one distinctly defined body to another, and the more frequently the vibration is transmitted from one body to another in a given space, the more nearly it is overcome. In a stone foundation, while the large blocks possess weight, and lying together, have great frictional resistance, a vibration will only be transmitted once or twice before the same is reached. In a brick foundation the same gross weight may be attained, and at the same time the vibration must pass from one body to another infinitely more frequently than in the stone foundation.

A LEVEL-HEADED BOY.

A BOY about fifteen years of age applied to a factory on Atwater street for the job of running a small engine in the place of a boy who had quit.

"Have you run an engine?" was asked.

"Yes, sir."

"You understand how steam works, do you?"

"I do."

"You know that water makes steam?"

"Of course."

"How is water got into a boiler?"

"By an injector."

"Suppose you have too much water?"

"Then I can't get steam enough until I draw it down."

"Correct. Suppose you haven't enough?"

"Then look out for an explosion."

"Correct again. Suppose you found the water almost gone and couldn't start the injector—what would you do?"

"Come upstairs and notify you to get your insurance policies out of the safe and make a sneak before she busted."

"You seem to be all right, young man; you can come on in the morning."—Detroit *Free Press.*

Mr. John Paynter, a widely known and highly esteemed engineer of Kingston, Ont., died in that city during the last month.

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SPARKS.

The Listowel Gas & Electric Light Co. (Limited) has been incorporated.

Two or three of the electric companies are anxious to introduce the electric light to the citizens of Drayton, Ont.

The Electric Light Co. at Rat Portage, Ont., has made a contract with the Council to light the streets for three years.

An expert will be employed by the Council to report on the best electric light system to be adopted by the town of West Toronto Junction.

Telephone communication has been opened during the past month, by means of a land and submarine cable, between the cities of Paris and London.

Messrs. Baird & Son, of Parkhill, have purchased an electric plant, and are supplying incandescent lights to the business establishments of the town.

The Nanaimo Electric Railway Co. will adopt the storage battery system of propulsion if its adaptability for the work can be satisfactorily demonstrated.

The Council of West Toronto Junction have decided to throw away $200 in sending a deputation of town fathers in search of information on the subject of electric lighting.

After exhaustive experiments the French post-office has decided to substitute a copper-coated steel wire in place of the ordinary iron wire for telegraphic and telephonic service.

The Building Inspector of Montreal is said to have condemned the tall chimney of the east end works of the Royal Electric Company, having found it to be defective 30 feet above its base.

Mr. Calder, chief of the Brantford fire brigade, has effected an arrangement for lighting instantly the gas jets by means of electricity. By this means a saving of $25 per year is realized in the gas account.

Incorporation has been granted the Ottawa Electric Street Railway Co. (Limited). Capital stock, $5,000,000. The promoters are: Thomas Ahearn, W. Y. Soper, W. Scott, D. C. Dewar and R. Quain, of Ottawa.

The Brooks Manufacturing Co., of Peterboro', have entered into a contract to supply all the carbons required by the Royal Electric Company of Montreal, averaging $1,000 per month. The company manufacture 10,000 carbons per day.

The Canada Permanent Loan and Savings Co. will sell by auction on the 15th inst. the premises and plant of the Hamilton Electric Light Co. to satisfy a mortgage. The city is interested in the matter, as the lighting contract has yet two years to run.

The Niagara Falls Electric Railway Co. is applying for incorporation for the purpose of constructing and operating an electric railway from a point near Niagara to a point near Port Erie. Among the applicants are Albert D. Shaw, John G. Scott, Benjamin G. Lake and Thos. McGaw.

Mr. John Griffin, Minneapolis, Minn., has invented a device for preventing electric street car wheels from slipping. The invention is a simple contrivance consisting of a revolving brush which is connected with the forward axle of the car by a belt. As the axle revolves it sets the brushes to revolving, brushing a path for the wheels about a foot wide. There is also a box for sand or salt, which lets down just enough without wasting any.

Hamilton *Herald:* The placing of telephone transmitters in churches puts a premium on laziness. A Hamilton man lengthened his wire in his house yesterday morning until he could hold the instrument to his ear comfortably in bed. Snuggling himself up beneath the bed covers he lay all morning listening to Canon Curran's discourse in St. Thomas Church.

The Bell telephone patent monopoly in England has expired. The patent there was granted for fourteen years. Cheap telephones will now prevail in England the same as in Germany, where Bell failed to obtain a patent. In the United States the Bell patent will expire March, 7, 1893, having been originally granted March, 7, 1876, for a term of seventeen years.

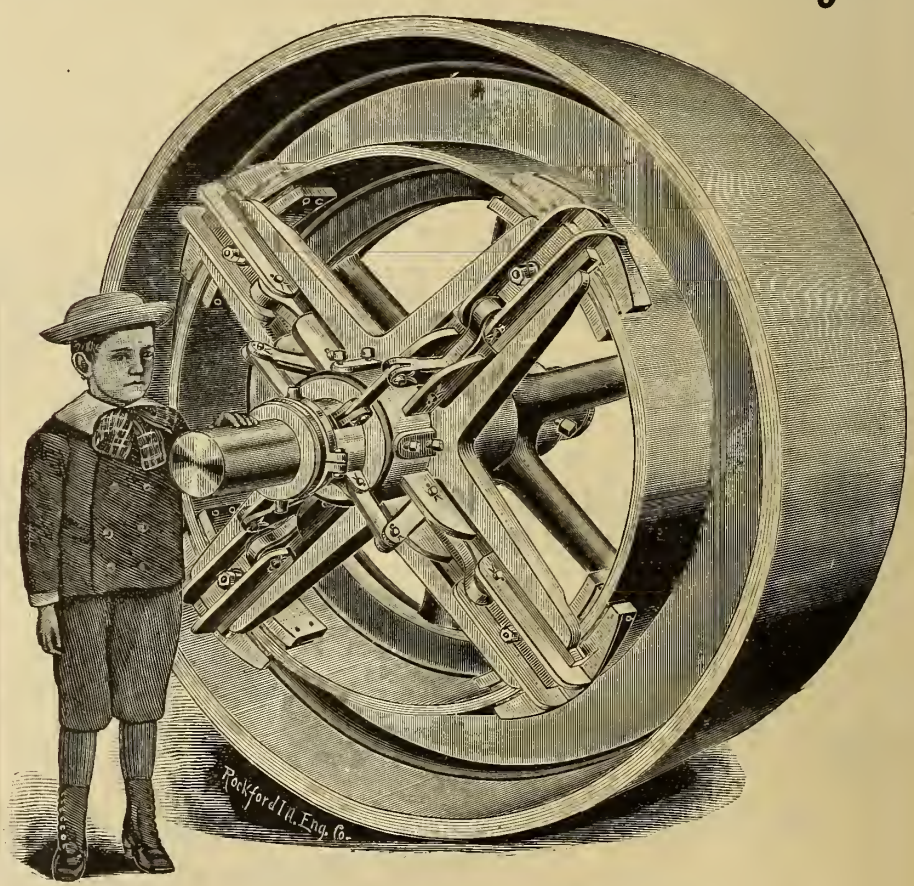
The new electric power house erected at New Westminster, B. C., is constructed of red brick, roofed with iron shingles. It has a frontage on the street of 45 feet and extends back 95 feet. It is divided into compartments, the larger being in front, and containing the dynamos and electric apparatus, office, etc. In the rear division is the generating machinery, which is of great power and weight. The boiler, engine and dynamo beds are of broken granite rock set in cement and covered with blocks of Nelson Island granite. The boiler bed has a foundation of 25 x 30 feet. The engine bed 24 x 16 feet; and the dynamo base is 8 feet square, tapering at the top to 8 x 4 feet. The boiler and engine have sufficient capacity for five times the present requirements.

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SPARKS.

The citizens of Merrickville, Ont., want the electric light.

It is the intention to light the streets of Madoc, Ont., by electricity.

The Arnprior Electric Light Co. sustained loss by the recent fire in that town.

The Brockville Incandescent Light Company will shortly enlarge their circuit.

The Bell Telephone Co. have just completed an electric fire alarm system for Napanee.

The Penetang Electric Light Co. intend putting in an engine to assist water power in the spring.

The Northwest Legislative buildings at Regina will in future be lighted by electricity instead of gas.

Application is made to the Legislature for a Bill to amalgamate the Kingston Gas and Electric Companies.

The Canada Electric Company of Halifax, N. S., are putting in another dynamo of 325 light power, at Amherst, N. S.

Incorporation has been granted the Fort William Electric Railway Co. Messrs. Donald and Peter Mackellar are among the promoters.

Tenders will be asked shortly for the construction of a proposed electric tramway at Nanaimo, B. C., the length of which will be 10 miles.

At a meeting of the directors of the New Westminster and Vancouver Railway Co. held a few days ago, the route for the road was definitely fixed.

The Windsor, Walkerville and Amherstburg Street Railway Co. have ordered 225 tons of rails and ten cars, together with all the machinery necessary to operate their line.

The Essex Brass and Iron Co., London, Ont., capital $30,000, has secured incorporation for the purpose of manufacturing brass and other metal goods, and electrical machines and appliances.

The Davenport Electric Railway Co. has been organized, with Mr. Jas. Austin as President, for the purpose of constructing an electric railway along Davenport Road from Toronto to Lambton.

Rapid progress is being made with the construction of the New Westminster and Vancouver, B. C., electric tramway. A portion of the machinery for the power house has arrived. Contracts have been let for the poles and wires, which will be erected at once.

Messrs. Ahern & Sopher have purchased property on Albert street, Ottawa, on which to erect car shops and offices, quarters for workmen, and work shop for repairs in connection with the proposed electric street railway. The building will be solid brick, 125 x 55 feet.

Property on the north side of the inlet opposite the city of Vancouver, B. C., to the extent of 1,279 acres has been purchased from Capt. Power, of Moodyville, by a syndicate of local capitalists, who will proceed at once to lay out a town site to be known as North Vancouver. Among the improvements to be carried out will be the construction of an electric railway to connect with the city lines.

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And over 1500 feet of 8 inch belting.

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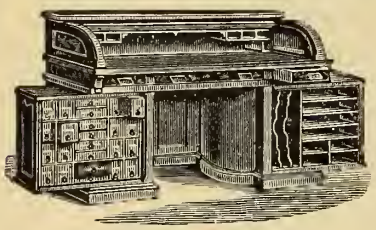
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Halifax Gas & Electric Light Co., Halifax, N.S.

New Glasgow, Nova Scotia.

Calkin Electric Light & Power Co., St. John, N.B.

Electric Light & Power Co., Woodstock, Ont.

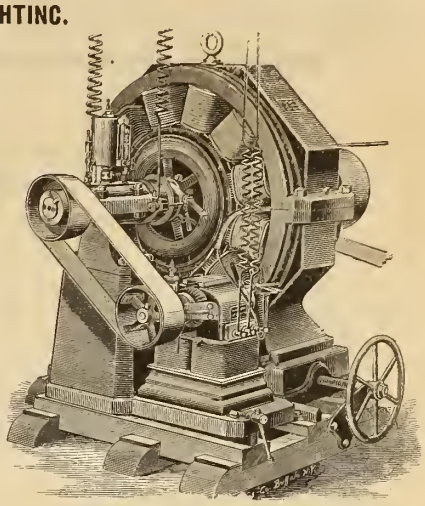
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TENDERS.

Sealed Tenders, addressed to the undersigned, and endorsed "Tender for Indian Supplies," will be received at this office up to noon of SATURDAY, 9TH MAY, 1891, for the delivery of Indian Supplies during the fiscal year ending 30th June, 1892, consisting of Flour, Beef, Bacon, Groceries, Ammunition, Twine, Agricultural Implements, Tools, &c., duty paid, at various points in Manitoba and the North-West Territories.

Forms of tender, containing full particulars relative to the Supplies required, dates of delivery, &c., may be had by applying to the undersigned, or to the Indian Commissioner at Regina, or to the Indian office, Winnipeg.

Parties may tender for each description of goods (or for any portion of each description of goods) separately or for all the goods called for in the Schedules, and the Department reserves to itself the right to reject the whole or any part of a tender.

Each tender must be accompanied by an accepted cheque in favor of the Superintendent General of Indian Affairs, on a Canadian bank, for at least five per cent. of the amount of the tender, which will be forfeited if the party tendering declines to enter into a contract based on such tender when called upon to do so, or if he fails to complete the work contracted for. If the tender be not accepted, the cheque will be returned, and if a contract be entered into for a part only of the supplies tendered for, an accepted cheque for five per cent. of the amount of the contract may be substituted for that which accompanied the tender; the contract security cheque will be retained by the Department until the end of the fiscal year.

Each tender must, in addition to the signature of the tenderer, be signed by two sureties acceptable to the Department for the proper performance of the contract on his tender.

This advertisement is not to be inserted by any newspaper without the authority of the Queen's Printer, and no claim for payment by any newspaper not having had such authority will be admitted.

L. VANKOUGHNET,
Deputy of the Superintendent-General of Indian Affairs.

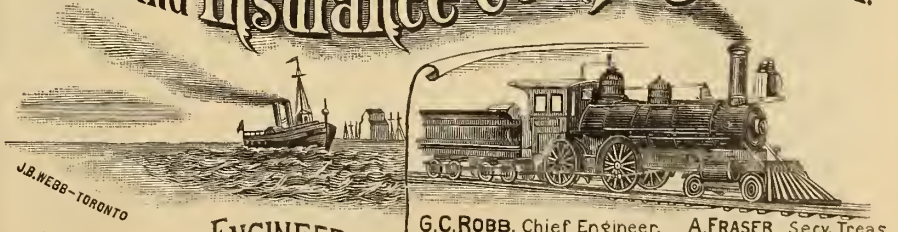
Department of Indian Affairs,
Ottawa, March, 1891.



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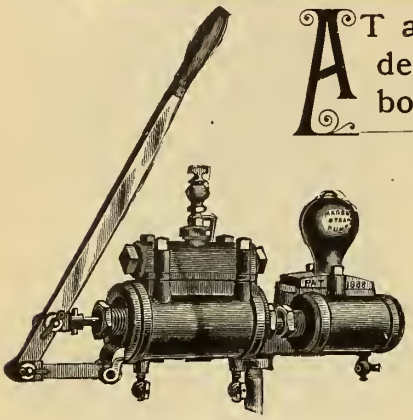
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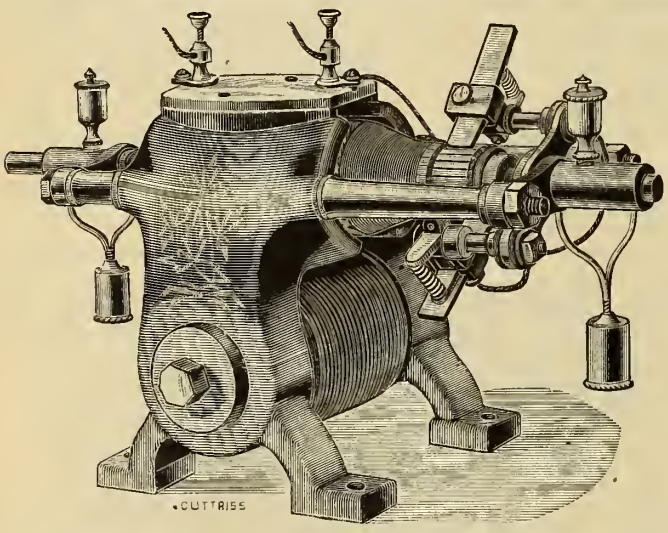
Absolute Actuation and Regulation without the use of Tappets, Levers, or other Mechanical Construction.

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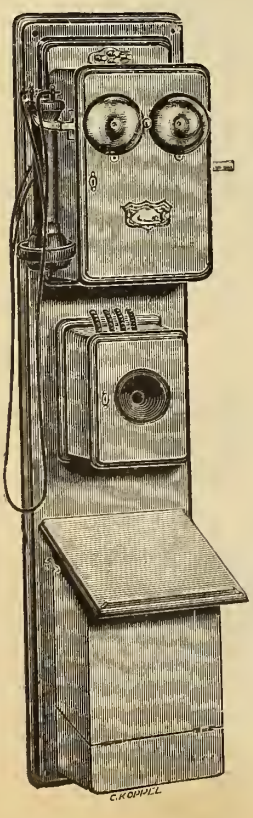
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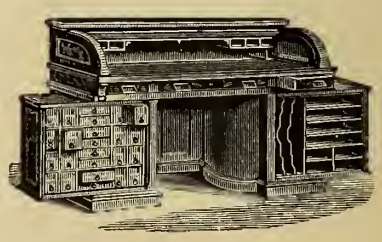
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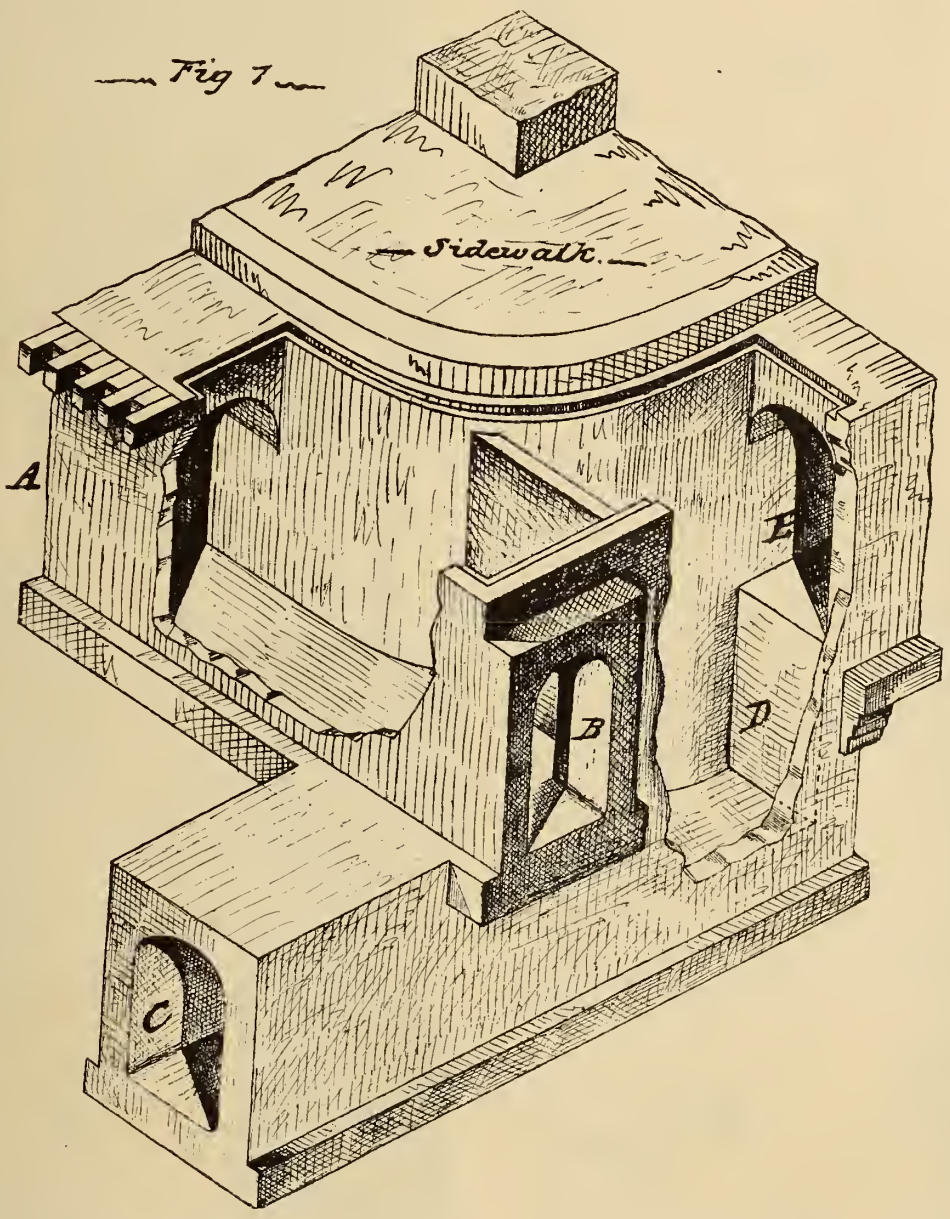
AND

STEAM ENGINEERING JOURNAL.

VOL. I. TORONTO AND MONTREAL, CANADA, MAY, 1891. No. 5.

DANSEREAU'S ELECTRICAL WIRE SUBWAY.

THE inventor claims as a main feature of his subway the use made of the street water course for the establishment of the conduits intended to receive the electrical wires. At street corners the subways cross one another at right angles, as shown in figure 1. The conduits A B and C D over-lap one another at levels differing as far as D, when the subway is again raised in E. In the conduits are placed cross-bars, shown in figure 2 and fully sketched in figure 3. In figure 4 are represented two different methods of laying the subway; in section *A* the curbstone is independent of the subway, whereas in section *B* the curbstone forms part of the subway.



The advantages claimed for this system of subway are the following:

1st. The use made of the water course, which is paved by the city, and consequently reduces by so much the cost of construction.

2nd. The use made of the curbstone, which affords a space not otherwise taken up either for public or private purposes.

3rd. The cost of construction of this subway which is reduced to a minimum, and the conduits do not in any way interfere with any private or public works.

Mr. M. E. Dansereau, of Montreal, the inventor of the above subway, is prepared to correspond with civic corporations or companies concerning arrangements as to the adoption of his subway.

One of the vexed questions in steam engineering to-day is, of how much use is the steam jacket? Some authorities say it is a valuable addition to a steam engine, others that it makes no appreciable difference in economy, and others still, that it is a source of positive loss.

THE QUEBEC EXPLOSION.

OUR contemporary the *Stationary Engineer*, of Chicago, in a recent issue referred to the Quebec Worsted Mill boiler explosion and gave a description of the arrangement of the boiler fittings and cause of the explosion differing from the account we published.

According to this Chicago version, there were three boilers with a large drum crossing over them, and with a shut off valve between each boiler and the drum, and the safety valves —three in number—all on the drum and none on the boilers. Our friend then proceeds: "As we look at the sketch, what little mystery remained about the disaster vanishes, and in its place is astonishment that any man, or set of men, be they owners, mechanical engineers, butchers, boiler inspectors, or just plain, every-day idiots, could have so little common sense as to construct so certain a death trap."

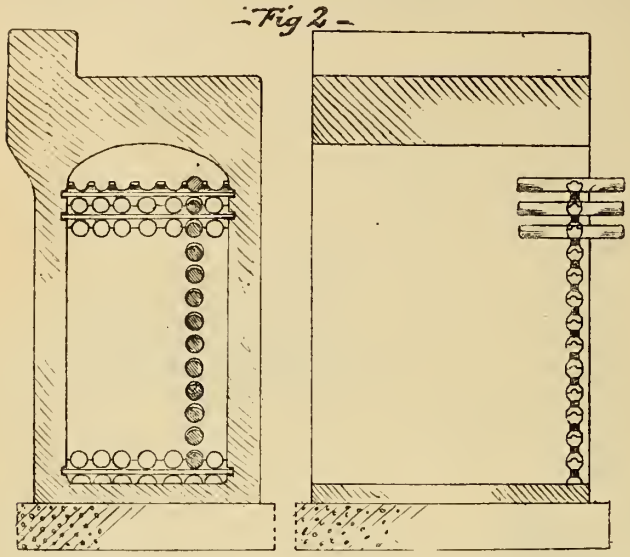
We have taken some pains to find out whether or not there was any truth in this Chicago story. We have positive assurance that the boilers were not arranged as our contemporary describes, but were as we formerly stated, three horizontal tubular boilers, each with a dome of the usual form, and fitted with a shut-off valve between each dome and the main steam pipe, and a safety valve on each boiler and not in any way connected with the steam pipe, and quite independent of the shut-off valve.

Our friend has been misinformed and wasted his thunder. We Canadians are foolish enough and stupid enough, but not

quite so verdant as the *Stationary Engineer* would have its readers believe. The safety valve of this exploded boiler was properly placed and of sufficient size, but carelessness had permitted it to become rusted to such an extent that the boiler burst before the pressure was high enough to open the valve.

Our friend says, "There must be some power to compel owners and superintendents to comply with the well understood

Fig 2



principles, and not allow them to be disregarded, no matter from what cause, whether avarice, carelessness, ignorance or idiocy."

Quite correct! The safety valve should never be stronger than the boiler, but when it is, or is allowed to become so, whether from "avarice, carelessness, ignorance or idiocy," it is better to tell the truth about it than to thunder about "the utterly idiotic lack of intelligence which was responsible for such criminal foolishness."

BELT WIDTH.

SOMEHOW or other, power users seem to be afraid to get belts wide enough to do the work that they put upon them. They will get a double thick belt, or strain what they have to that point at which the lacings are in danger of giving way, and the bearings are being worn by the excessive pull on them; they will daub printers' ink and other messes upon the belt, and do almost everything that they can think of, except get a wide enough belt in the first place. Extra width means extra driving power, so nearly every time, that it may be put down as a working rule. It nearly always means driving power in proportion to the width, other things being as nearly equal as they can be made. Almost any eight-inch belt should drive as much as a four-inch belt of the same thickness, material, condition, tightness, arc of contact, etc. Almost any 12-inch belt will under the same circumstances drive three times as much as the four-inch belt, and half as much again as the eight-inch belt, just like it in every way. It may cost a little more for pulleys of wide face than for those of narrow face; and it will of course cost more for wide belts than for narrow ones of the same thickness; but in nearly every case it will pay to give width. There

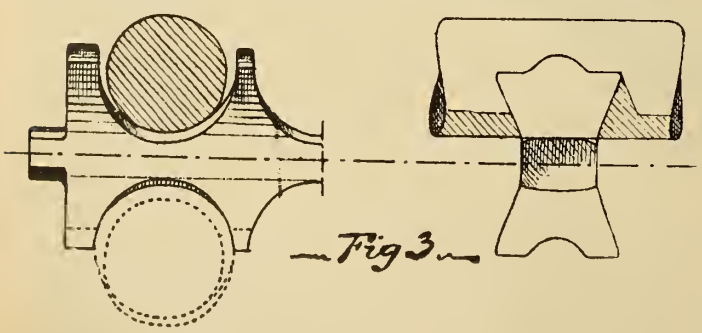


Fig 3

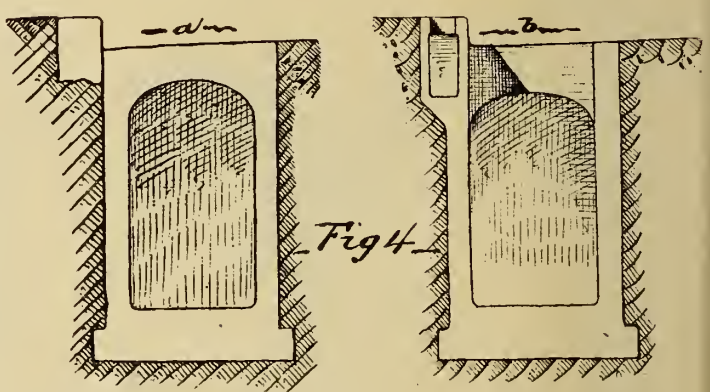
can be loss of time at a machine, and even all through a mill, by failure of a belt to start up with its load. The attendants of a machine may have to wait; every one in the whole establishment may have to stand around until the belt is tightened. This may take an hour. There may be 400 hands (pairs of hands) waiting for that belt to start its load. The extra width of belt, the extra face of pulley, can be paid for by the cost of a very few such stoppages; perhaps by only one.

But it is not always necessary to have extra cost of belt. The extra pulley face will often do the business; using a single belt of double width rather than a double belt of single width. A double belt does not really drive twice as much as a single one. It seldom drives more than half as much again. This being the case, it is better to have a 12-inch single than a six-inch double belt. If the belt be laced, the 12-inch single is really stronger as far as driving goes, than the six-inch double, because they are apt to be laced with the same material, or fastened with practically the same fasteners; and as it is the fastening which determines the strength of the belt, you may find that the 12-inch single belt has double as much strength of fastening to stand the strain, as the six-inch double.

There is one thing to be said about doubling the width of the belt to get double the drive; it will sometimes fail because the belt is too rigid to bed down well; and in such cases it will often be found that two six-inch belts, side by side, will drive more than one 12-inch. Of course a rubber belt can not be cut down the middle any more than a canvas one; but leather ones generally can, and this will often be found a good remedy when a wide belt will not drive. Of course when it is a question of substituting a wide belt for a narrow one, there is less difficulty and expense in getting another one of single width, than in discarding the first one and getting one of double width. The question is one of pulleys only.

Where there is considerable crown on a pulley and it is found by the appearance of the side next to the pulley that it is not bedding well, that the edges do not touch the pulley, the trouble may often be cured (with a leather belt) by scouring it down the

Fig 4



middle, half way. If it be a double belt it may be cut down through the outer layer only.—*Mechanical News.*

BOILER PLATES.

THE methods employed by Messrs. Cramp in the building of a large modern boiler, with thick plates for high pressures, are thus described:

The plates are, in the first place, pickled in a wooden bath containing a 5 per cent. solution of sulphuric or hydrochloric acid. After remaining in the bath for about six hours, they are removed and thoroughly scrubbed with hickory brooms, while a strong stream of fresh water is played upon them. They are then immersed in a bath of lime water to neutralize any remaining acid, and again washed with clean water. All holes are drilled, and the edges of the plates are planed and bevelled for calking. The shell plating is bent cold to the proper curvature in the rolls. The flanging is done by Tweddle hydraulic flanger, the plate being heated to a bright cherry red. A length of about eight feet can be flanged at each heat. Furnace mouth plates are flanged in cast iron dies at a single heat.

After the flanging of tube plates, etc., is completed, they are reheated, and the plates are straightened on a cast iron surface plate, and finally they are annealed by cooling in the open air from a cherry red heat.

The riveting is performed by a Tweddle hydraulic riveter, using a pressure of 1,500 lbs. per square inch on the flange, which gives a stress of about 90 tons on the rivet. The stay tubes are screwed into both tube plates and expanded, the ends in the combustion chamber being beaded over.

A MONTREAL ELECTRICAL SUPPLY HOUSE.

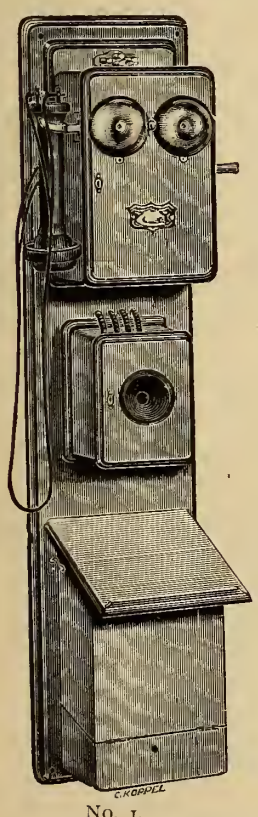
WE present to our readers herewith a brief description of an interesting visit which our Montreal representative made to the establishment of T. W. Ness, 644 Craig street, in that city.

Our correspondent writes: This firm is rapidly building up a

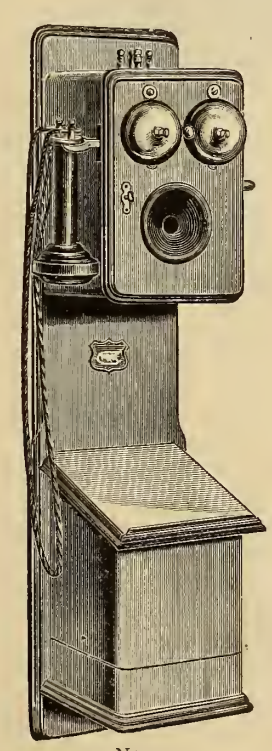


very large trade in electrical supplies. They have been running at full time all winter, and are still behind with orders, shipments being frequently made as far west as British Columbia, and to Newfoundland eastward, and each mail bringing enquiries from all parts of the Dominion.

The accompanying engraving will give a fair idea of the



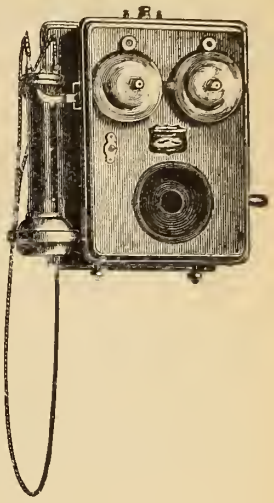
No. 1.



No. 2.

extent of the present premises, five flats being occupied exclusively by this one firm, the ground floor as an office and the others for show-rooms and factory, thus enabling the manager to have a personal supervision over all the work, which is in itself a great advantage.

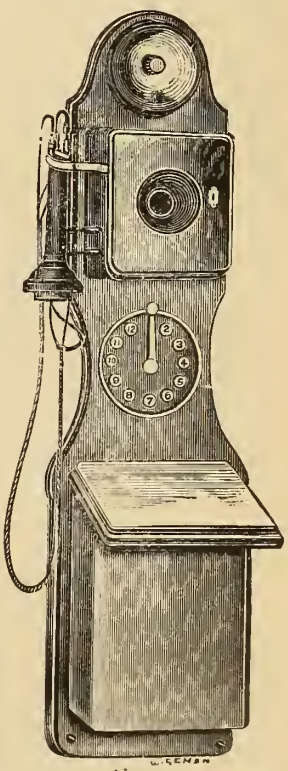
As manufacturers, a specialty is made of telephones, which are turned out in first-class order, thoroughly tested, and ready to be connected the moment received. Cut No. 1 shows the Exchange Pattern instrument, similar to the Bell. Cut No. 2 gives a cheaper form, having a transmitter and magneto combined in one box. Cut No. 3 represents a very neat telephone, so constructed that it may be placed on the desk, at the end of a flexible cord, for convenience in moving from one part of the desk to another, or, if desired, it can be mounted on a brass fixture with a swivel, thus enabling one to turn it aside when not in use. A small dry battery is used for this instrument, and may be placed in a drawer. This is a very convenient arrangement, and quite popular, especially with office managers. Warehouse telephones are also manufactured in large numbers, and so arranged that each instrument has its own switchboard, enabling any room or flat to communicate with any other, and, when calling, no bell rings other than the one wished for, (see cut No. 4.) The telephone department is in charge of a foreman who has had many years experience in Canada and the States and is a practical workman.



No. 3.

A large business is done in annunciators, which are here manufactured in a large variety of styles. Some of the largest public buildings in Montreal contain annunciators bearing the name of T. W. Ness, among the largest being one of 200 drops recently supplied to the Balmoral Hotel, connecting the different rooms with their office. Many special orders are received, but the principal kinds in general demand are the "Norway Iron Gravity Drop," the "Needle Annunciator," and the "Ness" Special Drop, fitted up of course in every possible style of case, but usually in oak, walnut, cherry, or ash; some very handsome frames were noticed in course of manufacture.

The machinery is all run by electricity. Your correspondent made particular inquiries in reference to the satisfaction given by this as compared with steam or other motive power, and the men all expressed themselves as perfectly satisfied with the system, and there is no doubt whatever that electricity has already become the most desirable power that can be used, as the running cost is practically nil, and the results perfection.



No. 4.

We were personally conducted through the spacious, well-lighted show-rooms. Everything to delight the heart of an electrician, from bells, batteries, induction coils, magnets, and telegraph instruments for the amateur, to motors, incandescent lamps, and electrical books for the more advanced students. A splendid assortment of combination fixtures, electroliers, and electric light shades of all sizes, shapes and colors is shewn. Electrical clocks, ventilation fans and electric gas lighting are all in active operation, every shelf, counter, and show-case giving a practical demonstration of a few of the many uses to which electricity is now being adapted. This house controls the Canadian agency of some of the special lines, such as "The Connecticut Motor," "The Auburn Watchman's Clock," "The Bundy Workmen's Time Recorder," "The Edison Lalande Battery.

We are pleased to note that the firm mentioned has succeeded in establishing such a good connection, and are sure that our electrical friends will be consulting their best interests by writing them for quotations.

MR. JAMES McARTHUR.

THE subject of the accompanying sketch is Mr. James McArthur, present President of the British Columbia Marine Engineers Association No. 1, which was formed at Victoria, B. C., in the early part of 1890. Mr. McArthur was one of the charter members, and has from the first taken a very lively interest in the organization and success of the Association.

Mr. McArthur is a son of old Scotia, having been born at South Queen's Ferry. Scotland, on the 22nd of March, 1850. He commenced to learn the engineering trade at an early age, serving an apprenticeship at the Paragon Works of James Dundas, of Dundas, Scotland. After working as a journeyman for a short time, he left Scotland in the employ of Tennant & Co., of Leith, by whom he was sent out to British Columbia in 1871 in charge of four traction engines for the late Mr. F. Barnard, who intended to use the engines to haul supplies to Barkerville. The enterprise, however, fell through, owing to the bad state of the roads, although Mr. McArthur succeeded in getting the engine he was in charge of considerably farther than was believed possible.

Mr. McArthur was next employed by the Kurtz & Lane Co. as engineer at the mines at Cariboo, but the mines not paying well, he returned to Victoria and engaged as chief engineer of the steamer "Cariboo Fly" for Messrs. Moody, Deitz & Nelson. Leaving this firm he became master mechanic for the Hastings Saw Mill Company for three years. In 1875 he purchased a half interest in the stern wheel steamer "Beaver," which ran on the Stickeen river. The following year she was lost, and Mr. McArthur returned to Victoria and took service in the then new Pioneer Line founded in 1877 by Capt. John Irving. He has since remained with this company, now the Canadian Pacific Navigation Co., Ltd., and is now chief engineer of one of the best boats, the "R. P. Rithet."



MR. JAMES McARTHUR.

Mr. McArthur is a man who has made a host of freinds, and by dint of hard and steady work and shrewd investments has accumulated a good share of this world's goods. He is married, and has a family of bright boys and girls. He is a prominent member of the Freemasons, Oddfellows and A. O. United Workmen; of the last he is a charter member. Having the confidence and esteem of his employers and the respect and admiration of his friends, Mr. McArthur is to-day one of the most popular engineers in British Columbia.

NEW INSULATING MIXTURE.

A NEW insulating compound called "voltite" is thus described: it is composed of a mixture of gelatine (specially made), resin oil, oxidized linseed oil, resin and paraffine. It is cheap, and contains no sulphur. The proportions of the mixture are: Glove glue (*colle de gant*), 1,000 parts; resin oil, 100 parts; oxidized linseed oil, 500 parts; colophane, 150 parts; paraffine, 250 parts. The glue is prepared by taking the refuse clippings of gloves, and soaking them in cold water for one night. The next day they are strained, and washed in several waters until the water is clear. In an iron boiler there are then placed 1,000 parts of water, five parts of carbonate of soda, and dry glove skin 250 parts. This is boiled for six consecutive hours, the water being renewed as it evaporates. The whole boiling mass is next run over a sieve, across which steam is passed to prevent the gelatine coagulating. The boiling solution is received by a wooden tub, through which a current of warm air is passed for one hour. The residue left in the sieve is boiled up with water for three hours, and when filtered can be used again for dissolving the glue, but this time with only 200 parts of glove skin. The gelatinous solution is put into a boiler with the olien or oleic acid used in candle manufacture in the proportion of gelatinous solution, 1,000 parts; olein, 80 parts. This is boiled for half an hour, after which ten parts of caustic potash solution (fifty parts water) is added. The boiling is maintained for an hour, so as to saponify the olein and form a soapy pulp. The glove glue prepared, resin oil, linseed oil, colophane and paraffine are added in the proportions above stated; the whole is boiled until homogeneous. This boiling generally lasts about four or five hours. —*Revue Industrielle.*

QUESTIONS AND ANSWERS.

"W. T." writes: Can you inform me as to what is wrong with my engine? It is a slide valve cylinder 12″ × 20″, revolutions 200 per minute. It seems to run very well until the large planer goes on, and then it loses speed.

ANS.—You do not give data enough for us to answer your question. Your governor may be at fault, your steam pipe may be too small, the valve may be set wrong, or be leaking, the piston may leak, or perhaps the engine is too small. Send us along full data and we will try to help you out.

"J. D." writes: I have a 6″ single leather belt running 1,600 feet per minute. The driver is 40″ in diameter, and the driven 18″. What horse power should this belt deliver?

Rule—Divide the number of square inches in contact with the pulley by 2; multiply this quotient by the velocity in feet per minute, and divide by 33,000. ANS.—You will have 4 ft. of belt contact on small pulley lever $48'' \times 6'' = \frac{288''}{2} = 144'' \times 1{,}600 = \frac{230{,}400}{33{,}00} = 7\frac{1}{4}$ very nearly; it would be safe to say $7\frac{1}{4}$ H. P.

"Engineer" asks: What would you recommend for taking out the scale that has become pretty badly crusted on the flues and bottom of a boiler?

ANS. — Slippery elm, flaxseed, ground sumac or any other mucilaginous seed or bark thrown into the boiler will loosen the scale, which can then be removed through the hand holes. When using any substance to remove scale, the boiler should not be allowed to run too long without cleaning out, as the loosened scale may accumulate on the bottom of the boiler and cause the sheet to burn.

"T. W." says: I am making a glass plate electric machine. Can you tell me how I can make the hole in the centre of the plate? I have tried twice but broke the plate each time.

Answer: Glass may be readily drilled by using a steel drill, hardened but not drawn at all, wet with spirits of turpentine. Run the drill fast and feed light. Grind the drill with a long point and plenty of clearance, and no difficulty will be experienced. The operation will be quicker if the turpentine be saturated with camphor gum. Large holes will require a tube-shaped tool with fine teeth like a rose-bit, using the same solution.

"J. M." asks: What would be the best way to determine the horse power a given belt would be capable of transmitting?

ANS.—The horse power of belting or the tractive force exerted by leather bands of a given width at a certain speed expressed in foot pounds or in any other positive way, is not generally known. There are some half-dozen rules professing to give a unit for horse power, but they are obviously incorrect. A horizontal belt of a given length will drive more than a vertical belt of the same length, a long belt more than a short one, and a twisted belt more than either, because in the case of the horizontal and the long belt the sag and weight tend to produce closer contact and resist strain better than where the belt merely hugs the pulley by its tension; the same is true of the crossed belt which embraces more of the circumference of the wheel driven. From six to eight hundred feet per minute for a one inch belt is said to give a horse power; three to four hundred for a two inch belt will give the same, and so on in inverse ratio.

Mr. J. P. Crawford recently delivered an interesting and instructive lecture on "Electricity and its Application to Light and Heat" before the members of the Hamilton Association.

ON THE STRENGTH OF TRIPLE-RIVETED BUTT-STRAP JOINTS.

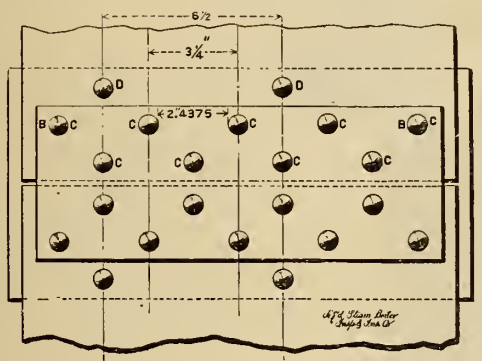
In the October issue of the *Locomotive* we gave Mr. John H. Cooper's solution of a problem in riveted joints, and in this issue we take pleasure in reproducing a solution of a similar problem by Mr. Van Clain, of the Baldwin Locomotive Works. The dimensions of the joint in question are as follows: The plates are of steel, ⅜ of an inch thick, and with a tensile strength of 55,000 pounds to the square inch. The rivets are of iron, ¾ of an inch in diameter, with a shearing strength of 45,000 pounds to the square inch. In the double riveted portion the pitch is 3¼ inches, and in the outside row it is 6½ inches. The problem is, to decide what the strength of the joint is, in terms of the solid plate, and in accordance with the Philadelphia City Ordinance, which does not expressly provide for joints of this character. Mr. Van Clain's solution of the problem was given in the September number of the *Locomotive*; but, as it was there given, it contained several typographical errors, which have been corrected in what follows:

There are three ways in which a joint of this character may fail: (1) by shearing all the rivets, which involves rivets *D* in single shear, and rivets *C* in double shear; (2) by a fracture of the plate across the line *BB*, and a simultaneous shear of the rivets *DD*; (3) by a fracture of the plate along the line *DD*.

Let us consider a portion of the joint 6½ inches long, say the portion included between the two long vertical lines passing through the rivets *DD*. The strength of the solid plate in a unit of this length is

Strength of solid plate $= 6\frac{1}{2} \times \frac{3}{8} \times 55{,}000 = 134{,}062$ pounds.

If the joint break in accordance with the first supposition, there are four whole rivets, *CCCC*, to be double-sheared, and one whole one, *D*, to be single-sheared. The diameter of the hole filled by



the rivet being, say, 13-16 of an inch, the sectional area of each rivet is .5185 sq. in. Hence

Shearing strength of $CCCC = .5185 \times 4 \times 2 \times 45{,}000 = 186{,}660$ lbs.
Shearing strength of $D = .5185 \times 1 \times 45{,}000 = 23{,}332$ lbs.

Strength of joint, on supposition (1) = 209,992 lbs.

The diameter of the hole filled by the rivet, 13-16, when expressed decimally, is .8125. If the plate breaks across *BB*, in accordance with the second supposition, the effective section in the part of the joint under consideration is reduced by twice this amount on account of the two holes punched or drilled for the rivets *CC* that lie on the line *BB*. Hence, the effective width of plate along this line is

$$6.5'' - (2 \times .8125'') = 6.5'' - 1.6250'' = 4.875''$$

Hence, the resistance of the 6½ in. section to fracture in this manner is

Tensional strength of plate along $BB = 4.875 \times \frac{3}{8} \times 55{,}000 =$ 100,547 lbs.
Shearing strength of one rivet in row $DD = .5185 \times 1 \times 45{,}000 =$ 23,332 lbs.

∴ Strength of joint, on supposition (2) = 123,879 lbs.

On the third supposition, we have merely to break the plate across

$$6.5'' - .8125'' = 5.6875''.$$

Hence, tensional strength of plate across $DD = 5.6875 \times \frac{3}{8} \times 55{,}000 = 117{,}305$ lbs.

In accordance with the Philadelphia rule, we are to take the least of the three strengths of the joint computed above, and divide it by the tensile strength of 6½ inches of the solid plate, which strength we have already found to be 134,062 lbs. Obviously, the joint is weakest along the line *DD*, so that we have to call its strength 117,305 pounds. Hence, the percentage of strength of the joint is

$$117{,}305 \div 134{,}062 = 0.875$$

Hence, the joint, in its weakest part, has 87½ per cent. of the strength of the solid plate.

It may be well to say that the number 2.4375" in the cut represents the distance in the clear from edge to edge of the rivet holes, though for the sake of clearness, it is shown as though it extended only from the head of one rivet to the head of the next.

IT LITERALLY FILLS A LONG-FELT WANT.

KINGSTON, April 18th, 1891.

Editor ELECTRICAL NEWS.

DEAR SIR,—I have received four issues of your valuable paper, the ELECTRICAL NEWS, and I find each number more interesting. It was just what we needed in Canada. I often felt annoyed that we were compelled to go to the States for such information, but thanks to your efforts that is now a condition of the past.

Yours respectfully,
CHAS. BAYLIE,
Electrician Kingston Penitentiary.

HORSE-POWER OF ENGINES.

Editor ELECTRICAL NEWS.

DEAR SIR,—Mr. John Galt, C. E., undertakes to act as a "governor" to me as to rate of travelling of horse to find horse-power of engine. This is all right as long as the "safety" and "throttle" valves are untampered with, the work will still go on with perfect "safety." I find it is necessary now for me to act as an "automatic regulator" to him, in that matter, to put him on *terrr firma*.

Horse power of steam engine is only a conventional way of expressing a certain size engine, and no two makes of engines are alike as to their horse power. But we will assume that H. P. is definite and alike in all engines for the sake of argument. All engineers from Watt down, except Mr. Galt, agree that a horse can exert his power to better or all advantage at two and a half miles per hour or 220 feet per minute, and *take that rate in calculating*. Mr. Watt calculated his H. P. on the largest London horse (Bourin). He was desirous of his engines doing all the work possible, or of rating them higher rather than lower, so that where steam was substituted he could dispense with a greater number of horses to do the work required.

Mr. Galt says that "rate at which horse is travelling is only one element in the calculation." Certainly it is only one element but it is *the* element that is wanting in his calculation.

Again, he says "note the rate at which the horse is travelling has every thing to do with the effect but has nothing whatever to do with the result." In mechanics this is incompatible. As I said before if you do not take the rate at which the horse travels into calculation, why take into calculation the rate at which the engine travels? The one must, of necessity, have the same units as the other in order to compare them, *which is 220 ft. per minute for rate at which horse travels*, in calculating the H. P. of steam engines. For illustration: H. P. of steam engine in numerator; power of horse in denominator

$$\frac{33{,}000 \text{ lbs.} \times 1 \text{ ft.} \times 1 \text{ minute} \times \text{speed of piston}}{33{,}000 \text{ lbs.} \times 1 \text{ ft.} \times 1 \text{ minute} \times \text{what?}} = 1 \text{ H. P.} + X,$$

when rate at which horse is required to travel is not taken into calculation. In formula form it is thus for calculating the H. P. of an engine.

Let A = area of piston.
P = steam pressure.
S = distance travelled by piston in feet per minute.

$$\text{H. P.} = \frac{A \times P \times S}{33000 \times 220}$$

If you would build an engine, by your formula, and guarantee it to be of a certain H. P., it would be like the New York street car horse—you would have to sing "Little Annie Rooney" to it before it would "budge" at the stated H. P.

We are all differently constructed—see, feel and think differently, and have different opinions. I like to see a man have his own opinions, and have backbone enough in him to assert his opinions, whether right or wrong.

Anyone who wishes to pursue the subject further may with profit study any of the following works: "Hutton's Practical Engineers' Handbook," "Mechanic's Own Book," Rankin's "Manual of the Steam Engine," Northcott's "Steam Engine," &c.

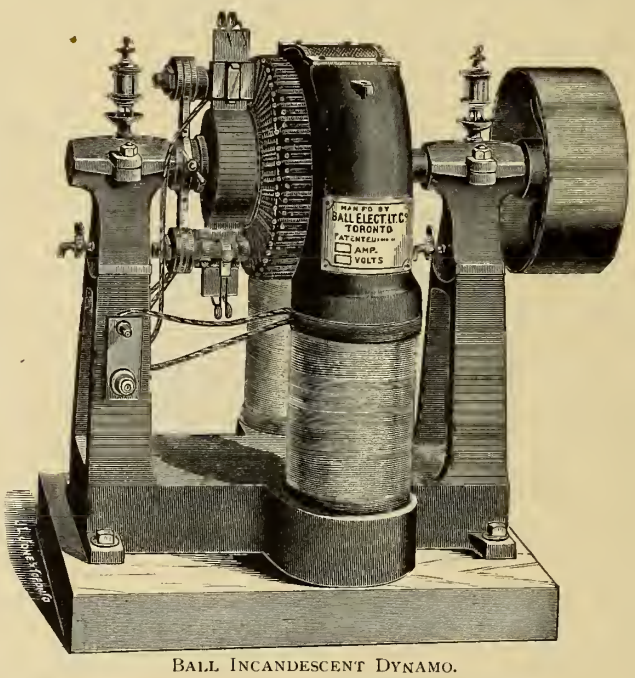
D. W. ROSS,
C. & M. E.

BALL INCANDESCENT DYNAMO.

THE dynamo illustrated herewith is manufactured by the Ball Electric Light Co., Ltd., 70 Pearl street, Toronto. While its general design cannot be claimed as entirely novel, yet there are many details of design and construction that are new. These combined with the high-class workmanship and good material used throughout, make, it is claimed by those competent to judge, one of the most efficient and best operating incandescent dynamos on the market. The makers claim it can be built and sold at a price which will make it an object to any consumer of 25 or more lights to own and operate their own dynamo, especially where they are already using power, or where a boiler is used for heating purposes.

The Ball Company also supply an automatic condensing engine for residence and shop use for driving these dynamos where other power is not available. These engines operate it is claimed at a cost not to exceed one cent per horse power per hour, and require but slight attention.

The general details of this new dynamo are as follows: A "Gramme" armature of the usual Ball type is used having a number of sections; this armature is securely mounted on a gun metal expanding hub. There can be no electrical connection between the wires of the armature and the hub and shaft, and no magnetic connection between core of armature and mounting hub, and consequently no tendency for the current to leave its usual path and no loss from magnetic leakage and foucault currents. The commutator is of tempered copper, and plates of ample length and section and insulated with mica. Carbon brushes are used on the commutator, and the machine operates without spark. On account of great depth of plate, the commutator will last for years without renewal. A newly patented brush holder very simple in design is used, giving a constant and adjustable spring tension on the carbon brush; this is a very important point and one which has hitherto been lacking in most dynamos. The magnet cores are of the softest special wrought iron. The inner surface of poles and the standards for bearings are bored at one operation, insuring perfect alignment. As gun metal interchangeable self lining and self oiling bearings are used, there can be no difficulty from heating of journal. These machines operate at very low speed, and as they are compound wound the regulation from no load to full load is automatic. These machines are wound for incandescent lighting in sizes from sixteen to one hundred and twenty five 16 c.p. lamps, and for arc lighting, from one to twenty five lights in either 2,000, 1,500 or 1,000 candle power. The Ball Company are also supplying the same class of machine wound for motor work for use on incandescent circuits.



BALL INCANDESCENT DYNAMO.

The above cut was taken from a 40 light incandescent dynamo. The larger sizes are built with a frame of different shape from above, bringing the base line nearer the shaft, so that in all of these machines there is an entire absence of any vibration which might otherwise be caused by pull of belt or speeding

The Ball Company report a large demand for these machines, and a number of various sizes already installed are giving good satisfaction. A full assortment of sizes are kept in stock ready for shipment.

The first electric tramway for mining purposes, to go into operation in Canada, will be put in the New Vancouver coal mines at Nanaimo. The plant, of which the first instalment will cost $20,000, consists of an 80 horse power generator, and two 30 horse power electric locomotives, each of which will haul at a speed of nine miles an hour, 150 loaded coal cars. Other generators will be used to furnish a current for light in the mines. Current will also be employed in working electric coal drills and cutters.

SPARKS.

An electric plant to be used for street lighting has arrived at Moosejaw, N. W. T.

Negotiations are in progress for lighting the village of Tottenham by electricity.

Heat produces electricity and electricity produces heat; magnetism produces electricity, and electricity produces magnetism; light produces electricity, and electricity produces light.

One part by weight of Greek pitch and two parts of burnt plaster is said to form a new insulation for electric wires which will stand either unusual heat or moisture. It is applied while hot by means of a brush.

A visit of inspection was made recently to the Edison Company's new works at Peterboro', by Mr. Francis, auditor of the company, and the manager of the company's works at Schenectady, N.Y. Some of the new buildings at Peterboro' will shortly be ready for occupation.

An agreement has been concluded between the city of Winnipeg and the Austin street car company, by which, on the introduction of electricity, the company's franchise is to be extended twenty-five years beyond the expiration of the present charter. Twelve miles of the electric road are to be built in 18 months.

An ingenious "cut off" for electric light fittings has been invented in England. Its novelty consists in securing the lead wire by two eccentric pinches, and in the fact that, should the wire melt from over current, the cover (which has an internal stud resting on the wire) will fly down, thus indicating what has happened.

The annual report of the Royal Electric Light Co., of Montreal, is considered by the directors to be of a satisfactory character. A quarterly dividend of 2 per cent. has been paid to shareholders after making additions to capital account. The prospects for the ensuing year are good. The officers and directors were all re-elected.

Time and trouble will be saved when winding armatures and field coils, by connecting a bell with one or two cells of battery to the armature or field core by means of a brush or swivel in the wire, and connecting the other end of the circuit with the end of the wire that remains on the spool. Any break in the insulation that permits a short circuit between the winding and the core will cause the bell to give instant notice of the fault.

The economy in large dynamos, it is said, will not come in their first cost, but in the expense of running them after installed. A 400 h. p. generator will cost to manufacture twice as much as a 200 h. p. machine. About twice as much material will be put in the former as in the latter, unlike a steam engine, but there will be a saving in winding the fields and armatures. The larger casting and a greater difficulty in finishing the base and other casting pieces will make up to an extent that which will be saved in winding the fields and armature. After the machines have been installed and put into operation comes the saving. Less care and consequently less labor will be required to keep them running properly, and as the speed will be materially lower, averaging from 300 to 400 revolutions per minute at their maximum, the possibilities of burning out an armature are much reduced from what they would be with an 80 h. p. generator, whose armature makes from 700 to 800 revolutions per minute.

Dr. Edward Tatum has recently completed some remarkable experiments on the physiological effects of alternating currents, says the New York *Electrical Review*. He finds that the danger of the current diminishes as the number of alternations per second is increased. Thus it took twenty times as strong a current to kill a dog when the alternations were 4,500 per second as when they were 120 per second. When the alternations were 300 per second, the current was only half as dangerous to life as when the alternations were 120.

We find this in an exchange: The introduction of electrical power into all the available mechanics of industry is but a question of time and the necessary economics in cost and application. The cutting of veneers is a new field for the magic force. The machine lately introduced, instead of cutting or shaving around the entire circumference of the log as usual, takes a thin slice from the flat side of it. The logs are of any diameter and are cut into lengths of 10 feet. It is fastened to two cranks. Between two parallel shafts a veneer-cutting knife is stationed, and the log is carried up and down in front of it with a circular motion by a revolving of the cranks, and is fed against the knife by a ratchet and pawl in the ordinary manner. This is the first instance on record where an electric motor has been used for this work. In the case here referred to, a 15 horse power machine is used for the purpose and the connections are made with the electric mains in the street. It is giving great satisfaction.

ENGINEERS' COMPETITION.

TORONTO, April 20th, 1891.

Editor CANADIAN ELECTRICAL NEWS.

DEAR SIR,—The papers for the Engineers' Competition which you handed to us for examination have been carefully gone over by us, and as a result we have to report that Mr. A. E. Edkins, engineer at Messrs. T. Eaton & Co.'s, Toronto, is entitled to the first place, and that Mr. G. C. Mooring, engineer at the Methodist Book Room, Toronto, is entitled to second place. Mr. Edkins received 510 marks out of a possible 670, and Mr. Mooring was not very far behind, his losses being mainly in the answers to three questions.

We regret that so many engineers in the country did not avail themselves of this competition, as we are convinced a large number could have answered the questions with a little study.

We hope that at some future time you will see your way clear to give them another opportunity.

Yours very truly,

GEO. C. ROBB,
A. M. WICKENS.

The following table shows the number of marks obtained by each candidate:—

	Wm. Sutton.	G. C. Mooring.	A. E. Edkins.	E. Tipton.
No. 1	20	15	10	10
" 2	30	40	35	—
" 3	45	60	60	60
" 4	20	20	20	20
" 5	30	60	50	20
" 6	70	80	80	—
" 7	30	20	40	—
" 8	15	20	15	15
" 9	20	20	40	—
" 10	—	—	—	—
" 11	20	30	60	—
" 12	—	40	30	—
" 13	10	10	20	—
" 14	20	30	20	—
Neatness	10	—	30	—
Total	340	445	510	125

The questions submitted for solution in this competition and the answers given by Mr. Edkins, the successful competitor, are printed below:

1. What is a horse power as applied to a boiler?

Answer—The basis on which the H. P. of a boiler is rated is the evaporation of one cubic foot of water at 212° to steam, per H. P. per hour. This rating was established some time before the automatic cut-off engine came out, and when the actual consumption of engine was about that figure. In my opinion the term H. P. of a boiler is very vague, and depends on the relative economy or wastefulness of the engine. I believe that the modern high grade automatic cut-off engine, working non-condensing, will in ordinary practice develop two H.P. to every one H.P. at the above named boiler rating. The amount of heating surface in the ordinary tubular boiler which is necessary to evaporate one cubic foot of water is conceded to be 15 sq. ft., and it is generally allowed that that amount (15 sq. ft.) is equivalent to one H. P. in a tubular boiler, also 12 sq. ft. in a locomotive type of boiler, and 9 sq. ft. in a plain cylindrical boiler is equal to one H. P.

2. How much is gained if feed water can be had at 120° temperature instead of 40°?

Answer—7½ per cent. is gained.

3. With water at 40° fed into the boilers, and steam taken off at 90 lbs. pressure, how much coal should be required for each thousand gallons of water used?

Answer—1250 lbs. per 1,000 gallons; but I think in practice more than this would be necessary.

4. What would be the safe working pressure for a horizontal tubular boiler, 64 inches diam., 14 feet long, with 90 tubes, 3 in. diam., shell made of 60,000 lbs. steel plates ⅜ in. thick, and double rivetted in longitudinal seams?

Answer—The safe working pressure is 98 lbs. per sq. in. (Reed's rule).

5. Give size of furnace for soft coal for such a boiler, and size of smoke pipe, and area and height of a chimney for a range of six boilers of same dimension?

Answer—Area of furnace, 2,475 sq. ft. = 4′ 6″ × 5′ 6″. Size of smoke pipe, 5′ 6″ × 6′. Area of chimney, 30 sq. ft. Height, 100 ft.

6. An engine has cylinder 18 in. diam., and 18 in. stroke, and makes 240 revolutions per minute. Steam is supplied at 90 lbs. pressure in boilers 30 ft. away. What size should steam pipe be?

Answer—Size of steam pipe should be 6″.

7. With steam cut off in above engine at ⅛ in. of the stroke, and discharged into a heater open to the atmosphere, what horse power can be got?

Answer—I find by building a theoretical card under these conditions, that I get a M. E. P. of 34 lb. and 194 H. P.

8. If a condenser be added, maintaining a vacuum of 26 in. on the guage at the condenser, what *additional* power could be got from engine?

Answer—By adding a condenser would gain 20 per cent.

9. What difference to the amount of fuel per horse power per hour should there be between above engine using a heater giving water at 190° and using a condenser, maintaining a vacuum of 26 in., and supplying feed water at 100°?

Answer—There will be a difference of 55 lbs. of coal per H.P. in favor of condensers.

10. If engine speed varied while the pressure of steam and load were constant, what should be done to remedy the defect?

Answer—There are several things that would cause an engine to vary in speed, under these conditions, for instance: The centrifugal force of the fly-balls of governor not being correctly counter-balanced; the fly-wheel might not be of sufficient weight; the governor belt might not be sufficiently tight to prevent slipping.

11. In a high speed automatic cut-off engine, what is the effect of the weight of the reciprocating parts on the steadiness of motion?

Answer—The effect is to equalize the pressure on the crank pin this way During the first half of the stroke the reciprocating parts are being rapidly accelerated in motion, and while such is the case, they absorb considerable of the work done by the pressure of the steam on the piston, and, after mid stroke, give off this same amount of work on the crank pin in coming to rest. All the work done on the piston (minus friction) is transmitted to the crank pin, but the crank pin is protected from the tremendous blow which it would otherwise receive when steam is admitted to cylinder, by the weight of the reciprocating parts and for these reasons I would say, the effect is to equalize the pressure on crank pin.

12. The duty of the governor is said to be to regulate the speed; upon what conditions does its power to regulate depend?

Answer—Upon the governor balls being properly counterbalanced, and the fly-wheel being of sufficient weight, also that governors be kept in a proper state of lubrication.

13. What are the advantages of "compression" in the steam cylinder?

Answer—The advantages are that when properly utilized it can be made to fill the clearance space at initial pressure, and if this is done, there is no great loss by clearance. It also forms an elastic cushion, and this assists to bring the piston easily to rest at the end of each stroke. It also, when properly used, prevents the piston from sustaining any shock, when steam is admitted to cylinder, and in performing these functions, it tends to make an engine run easily and smoothly.

14. Describe the defects in the annexed diagram, and state what should be done to remedy them.

Answer—This card indicates that everything is late opening and closing. I would put the eccentric forward the necessary amount. It is possible that the steam pipe, or ports, or exhaust pipe or ports, are too small; judging from card I would say they are.

The answers given by Mr. G. C. Mooring, the winner of the second prize, are as follows:

No. 1. Watts' standard, one cubic foot of water evaporated in one hour; but of later date, and with an automatic engine, 30 lbs. evaporated per H. P. per hour.

No. 2. 71% saving.

No. 3. If 70% of the heat in the coal can be utilized, it would require 1,160 lbs. of coal per 1,000 gallons of water.

No. 4. 98·437 lbs.

No. 5. Rate of heating surface to grate surface, 45 sq. ft. to 1, equals 26 sq. ft. Smoke pipe connection, 27 sq. ft. area. Chimney, 110 ft. high. 33 sq. ft. area.

No. 6. Steam pipe, 6″.

No. 7. 230·46 H. P.

No. 8. 25% additional power.

No. 9. Saving of fuel, 8%.

No. 10. Make the governors work right.

No. 11. They assist the governors.

No. 12. Upon its being properly balanced in proportion to its work, and to be kept clean and well oiled in every part, allowing it to regulate the valve or valves with the highest variation of speed.

No. 13. It forms a cushion to ease the engine off centres and partly fills the ports, thereby saving live steam.

No. 14. The valves are late in all their movements. Advance the eccentric.

RECENT CANADIAN PATENTS.

No. 36074. John Platt, Removing incrustation.
No. 36075. " Cleaning boiler.
No. 36094. M. Swinbourne, Ball valve.
No. 36098. G. E. Hitch, Storage battery.
No. 36116. Jos. Burns, Hydro carbon burner.
No. 36135. E. R. Gill, Electric circuit controlling apparatus.
No. 36195. E. Fales, Generating steam.
No. 36196. P. Fitzgibbons, Boiler.
No. 36214. H. Patterson, Steam boiler.

TRADE NOTES.

It is at this period of the year that the engineer's thoughts sorely turn to remembrances of heated axles, hot boxes and such; and he sadly wonders if a heated axle can make life in this world so unbearable, what must it be in the hereafter? The engineer is necessarily a man of intelligence, of quick perception, and of a trained and disciplined mind. He is capable of judging a good thing when he gets it, and once he gets what he wants, no counterfeit fakes need apply. The engineer who is worried just now about hot boxes has not tried Spooner's Copperine, otherwise he would be wondering why earth should be unhappy while Heaven leaves us Youth and Love, and Spooner gives us Copperine.—Bobcaygeon *Independent*.

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EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

THE result of the Engineers' Competition instituted by the ELECTRICAL NEWS for the benefit of its subscribers, is given in the present number. Answers to the questions propounded were received from only *four* engineers. The lack of interest thus indicated is at once surprising and disappointing. It was the intention that this competition should be followed by others, but under the circumstances it would seem advisable to postpone further efforts in this direction until Canadian engineers feel the need of and manifest some desire for self-improvement.

THERE is much disappointment expressed by representatives of the electrical industries of the United States as the result of the recent discovery that the dimensions of the proposed electrical exhibition buildings in connection with the Worlds' Fair are inadequate for their purpose. Unless the chief architect can be prevailed upon to change the plans which have been prepared, the electrical exhibits, instead of being centered in one building, must be distributed amongst several. Such a distribution would be most unsatisfactory both to exhibitors and visitors. It is, to say the least, peculiar that Prof. Barrett, Chief of the Department of Electricity in connection with the World's Fair, seems not to have been consulted in a matter of such importance.

AT the request of a number of our subscribers, we have opened in the present number of the ELECTRICAL NEWS a question and answer department, which it is hoped will become one of the most valuable features of this journal. Every man who finds himself called upon to operate electric or steam plant, is confronted occasionally with puzzling problems, the solution of which he would thankfully be made acquainted with. When the reder comes across a knotty problem of this nature, let him bethink him of the question and answer department of this journal. Write down as concisely and clearly as possible what you want to know, and every effort will be made to supply you with the information. It is not expected, however, that you will be like a sponge, absorbent only; we want your assistance in answering questions whenever you may be in a position to give it.

APPLICATION has been made to the Council of the city of Toronto on behalf of the Toronto Telephone Company, a new organization, for permision to string wires and exercise privileges similar to those emjoyed by the Bell Company. That the application is supported by the signatures of 2,000 ratepayers, is sufficient proof that the telephone users of the city are not satisfied with the present condition of affairs, under which they undoubtedly are compelled to pay too high a price. If two telephone companies were in operation, however, a telephone of each system would become a necessity, precluding the possibility of lessening the cost and complicating matters in such a way as to add to the annoyance which not unfrequently is experienced where only one system is in use. A plan preferable to that of bringing into operation a second company, would be to place such restrictions upon the existing company as would insure to the citizens a cheap and effective service.

THE season is now rapidly approaching when it behooves the careful manager of a central electric plant to look well to his lightning arrester, or if he has not such a useful little contrivance on his lines, to see that a sufficient number are placed there without delay. In the early days of electric lighting, numerous casualties happened to dynamos without any apparent cause. Some of these were no doubt due to defective insulation, but the majority of cases owed their origin to the insidious but lively spark of static electricity. It was not at all necessary for the trouble to happen in the midst of a howling thunder storm where there could be no mistake at all about the wires being "struck by lightning" as a self-evident fact. A very slight atmospheric disturbance, in an electrical sense, perhaps even on a clear night, might be abundantly sufficient to produce a tiny spark which, jumping from the wire of a dynamo to the iron core, carried with it the current of the machine. In fact, instances have been frequent where the static electricity generated from the driving belt has grounded the dynamo current and burnt out the machine. At all events, all wires running on poles should have efficient lightning arresters where they enter the building of the central station. This is especially necessary now where circuits of from ten to twenty miles are of common occurrence. The loss of time and expense caused by the grounding of the current on the core of a single dynamo would more than pay for a complete outfit of arresters for a whole station, and it is an occurrence likely to happen a number of times in a single season in an unprotected establishment.

THE town fathers of West Toronto Junction are making such an exhibition of the results of municipal handling of an electric light business as to afford a pointed illustration of our oft repeated opinion that the exploiting of such things should be left to private enterprise. They have been at it nearly a year now. Some months ago a by-law was passed appropriating fifteen thousand dollars to be expended in purchasing electric light plant, but so far nothing has been done except to squander the town's good money in a councilmanic jaunt to various cities to see electric light. This would not be so bad, or so much worse than is usually the case if they had stopped the excursion when the municipal grant was all expended, but to continue the trip to various cities at the expense of a would-be contractor was a glaring breach of the unwritten law of good taste, as well as a direct violation of the statutes in that case made and provided. It requires no great strain on the English language to designate a free excursion at the expense of a tenderer on a corporation contract as a method to produce an undue influence, or in other words, to act as a bribe in their favor when the award is considered. It now appears that while the committees have been wrangling over the merits of their various favorities they have allowed the time to expire during which they should have given notice to annul the gas contract. The constituents of these civic solons will therefore have the privilege of revelling in the semi-darkness of the gas lamps for another year at least. When the immortal Winkle was out shooting, Sam Weller suggested that as they would likely come up with a covey of partridges in the next field, he had better begin to fire at once and he would perhaps get the shot out of the barrel by the time the birds would rise. Perhaps if the West Torontonians begin in earnest to get their electric light system, it might possibly be in operation before the expiration of the extra year that fate has so kindly vouchsafed to them.

THE suggestion made by Mr. Gibson in his capacity of Chairman of the Legislative Committee to the delegation of stationary engineers who recently waited upon that Committee, was an exceedingly good one and one that the engineers would

do well to seriously entertain. It was that they should endeavor to obtain a legal standing by means of a charter, something after the manner of the Architects' Association, and themselves appoint a Board of Examiners, who would have power to issue diplomas or certificates of competency to the members. These would undoubtedly carry much weight with steam power owners desiring the services of the best and most skillful men. The association could then, by a guarded and careful use of the powers conferred upon it, raise the standard of qualification considered necessary for the position of a first-class engineer without doing injustice to a large class of men, perfectly practical and able to fill minor positions with acceptance, but who would be unable to pass an examination in the higher branches of the art. The Bill before the Legislature for the inspection of boilers and licensing of engineers is presumably introduced for the protection of the public, and in the public interest. This being the case, it is difficult to see why steam powers under fifteen horse power should be exempt. It is notoriously this class of boilers that cause the most trouble, and the reason is not far to seek. They are usually tended by men or boys with no special qualifications for the work, and who frequently have the most of their time and attention occupied by other matters. Large installations of steam power are usually in the hands of men who know enough not to risk their own lives or the lives of the public, whatever they may know about the economical management of the machinery under their charge. The opposition developed to the passage of the Bill in question was no doubt largely due to this appearance of class legislation, but if the Association had under their own control, in the manner suggested by Mr. Gibson, the examination and certificating of their own members, the difficulty would be obviated by a proper grading and classification according to competency and experience. An employer would then by application to the society be enabled to obtain a man who could be relied upon as competent to take charge of anything from one horse power to one thousand, as might be required. And now a word in the ear of our friends of the engineering society. Remember that no amount of legislative enactment will increase the value of the services of an incompetent or careless man, or raise the standard of the profession. You have in your own hands the means of attaining a higher position and increased emolument, but it will not be by an Act of Parliament or by assuming any position that savors in the slightest degree or has the most remote appearance of an attempt at coercion. Leave such things to those whose intelligence and abilities are not great enough to place them on a higher plane. You can do it by making for yourselves and your society a reputation that will *command* respect. Let your members be painstaking and conscientious in the discharge of their responsibilities. Waste no time in listening to the blatent harangue of the demagogue or in profitless hunting around for the few soft spots that may perchance be found admidst the hard and stern realities of life, but rather seek to improve the precious moments by an earnest endeavor to attain that knowledge and perfection of skill that shall compel the attention of those whose province it is to judge. Do this, and see that there is no favoritism in your recommendations, but that a high standard of merit and character is required, and your certificate will be more sought after and carry more weight than the best of government endorsement which any man, whatever his character may be, could probably purchase by the judicious expenditure of a five dollar bill.

PERSONAL.

Friends of Mr. J. A. Ferguson, the able chief engineer of the Toronto water works, will regret to learn that he is incapacitated by illness from performing his duties for a season.

Mr. O. P. St. John has resigned his position as steamboat inspector at Toronto, and has gone to British Columbia as the representative of the Doty Engine Co. of this city. Mr. St. John possesses the practical and scientific information, which added to a kind, gentlemanly demeanor, will undoubtedly secure for him and the company he represents a large measure of success.

The following comparison shows the great economy of electricity over water power for elevators: The duplex steam pump uses 8 pounds per hour for each h. p.; the engine which drives the dynamo to furnish electricity to the same extent uses, at most, 4 pounds. Only one-fifth of the power developed in the driving engine is used for operating the elevator. The safety appliances of one kind may be applied to all.

WHAT HAPPENS WHEN THE VALVE OPENS.

By A. N. Somerscales.

So long as a safety valve remains shut, the steam pressure acting on the underneath side of the valve is opposed by the weights of the load resting on the top, which may be either dead weight, a helical, spring, or an arrangement of one of these acting through the agency of a lever.

Now, either by calculation or by trial, it is possible to proportion the load to the area of the valve so that the valve shall be lifted off its seat when the steam has reached any particular pressure fixed upon as the blowing-off pressure.

Thus, if the area of the under side of the valve exposed to steam is exactly 12 square inches, and the steam is required to blow off at 100 pounds per square inch above the atmosphere, it will be necessary to provide a load $= 12 \times 100 = 1200$ pounds upon the valve, including the weight of the valve itself.

It is thus clear that the first condition, namely, that the valves shall open when the pressure reaches a certain determined amount, is not difficult to fulfil.

But now consider what happens when the valve opens.

The slightest amount of lift off the seat allows the steam to escape in all directions through the annular orifice between the edge of the valve and seat.

Its velocity is very great—probably 800 feet per second.

The steam in the immediate neighborhood of the valve seat escapes first, and its place is necessarily taken by other steam from the boiler, which also escapes.

A current is thus set up, not only through the orifice furnished by the valve, but also through the pipe leading to the same.

Now, a fluid will not commence to flow unless there is less pressure in front than behind.

When we find, therefore, that the steam is rushing up the pipe leading to the valve seat, with any considerable velocity, we may be certain that there is less pressure at the top of the pipe near the valve than at the bottom of the pipe next the boiler.

In the case of a dead-weight valve, if it has to remain open and permit steam to escape, there must be as much pressure under the valve as balances the load on top.

And as we know that the pressure under the valve is less than the pressure in the boiler, the sole condition under which the valve can be kept open and allow steam to escape is that there must be some (however slight) accumulation of pressure in the boiler over and above the load on the valve.

For example, we may suppose the valve loaded to 100 pounds per square inch, and the difference in pressure between the top and bottom of the pipe to be 4 pounds when the steam is escaping.

Under these conditions the boiler pressure will become 104 pounds when blowing off.

To trace the action of the valve more closely, we may say that when the steam first begins to blow off, the valve will rise a very small distance off the face—so little indeed that the velocity of the steam up the pipe will be small, and the reduction of pressure at the under side of the valve inappreciable.

The small orifice thus opened being insufficient to relieve the boiler, an accumulation of pressure will result.

The extra pressure acting on the valve will increase the lift until the reduction of pressure through the velocity of the steam in pipe is only just sufficient to balance the load on the valve as before.

If the boiler is still making steam faster than it is escaping, a further accumulation will occur, and a further adjustment take place.

But at any instant the pressure on the under side of the valve will always be 100 pounds above the atmosphere, even when the accumulation of pressure in the boiler is considerable.

Now, in order to prevent any considerable accumulation of pressure occurring when blowing off, it has always been the practice to make safety valves very much larger than the size of orifice actually required for the escape of all the steam which the boiler can make.

If an area of about one-thirtieth of a square inch is actually required for the steam to blow through, the board of trade requires an area of half a square inch in the safety valve.

Such being the practice, it follows that safety valves only need to lift a small fraction of an inch off their seats when blowing off, thus avoiding much accumulation of pressure due to the cause we have been considering.

STEAM ADMISSION.

I.

In every line of business some men are content to go on year after year doing the same kind of work in the same way. If asked why it is done in such a way and not in some other way, they can give no better reason than "It has always been done this way." There is no royal road to a knowledge of engineering, and the man who is too indolent to think for himself, or to discover any better reason for doing a thing in any particular way than that "it was done that way before," had better find an easier occupation. The man who has charge of a steam engine should be master of the engine, so far as knowing how to keep it in order and make it do the work it was intended for.

The action of steam in the engine is a subject well worth studying, and every man who runs an engine should know at least something about it, and of the reasons why one engine works better than another. One point to which too little attention is given is the admission of steam to the cylinder. The aim of correct admission is to get, as nearly as possible, the full boiler pressure on the piston at the right time. What constitutes the right time need not be considered at present, as it is a different question from that now under consideration.

With any given engine, how may the engineer know whether or not it is possible to get anything near the boiler pressure into the cylinder? The quantity of steam to be transmitted from the boiler into the cylinder in a given time is what really determines the matter.

As a matter of fact, a loss of ten pounds, or fifteen pounds, between the boiler and piston is not uncommon. Engines can be made that the difference will be so little as hardly to be discernable. It has been proved that if in following the piston, or rather in driving it, the steam has to flow through the pipes and ports at a velocity higher than one hundred feet per second, there will be a loss of pressure; but if the steam pipe and ports are made so large that the steam velocity through them is one hundred feet per second or less, then there will be scarcely any loss of pressure, unless from the condensation that takes place when the pipes are not properly protected.

This, however, does not give an immediate answer to the problem, because the question arises, what is the velocity of the piston? At the beginning and end of each half revolution, it has no velocity, and at about half stroke it is going as fast as the crank pin, while the number of feet travelled per minute is much less than that travelled by the crank pin.

Take for an example the case of an engine with a cylinder eighteen inches in diameter, and a stroke of three feet, and intended to be run at eighty revolutions per minute, what size should the steam pipe be in order to admit full pressure up to half stroke? In this engine the piston will travel four hundred and eighty feet in a minute, but at about half stroke it will be moving at a rate of nearly seven hundred and fifty-four feet per minute.

It was stated that the steam should not move faster through the pipe than about one hundred feet per second, that is, six thousand feet per minute; now if the piston is moving only seven hundred and fifty feet per minute, the area of the steam pipe may be as much less than the area of the piston as seven hundred and forty is less than six thousand.

The rule may therefore be stated thus: Multiply the area of the cylinder by the speed of the piston at the point in the stroke to which boiler pressure is required to be maintained, and divide by six thousand, and the result is the area of the steam pipe.

In the example considered, this rule would call for a steam pipe six inches diameter, but if the full pressure is to be maintained for only quarter stroke instead of half stroke, then the mean piston speed of four hundred and eighty feet may be taken instead of the highest piston speed, and a pipe five inches will answer.

A SIMPLE STEAM PRESSURE CALCULATOR.

By Wm. Cox.

The accompanying diagram, an original design by the writer, is a species of circular slide rule by which the theoretical average pressure per square inch resulting from any possible cut-off and initial pressure can be instantly determined, or conversely, given any average pressure, the several combinations of cut-off and initial pressure which will produce it can be at once determined.

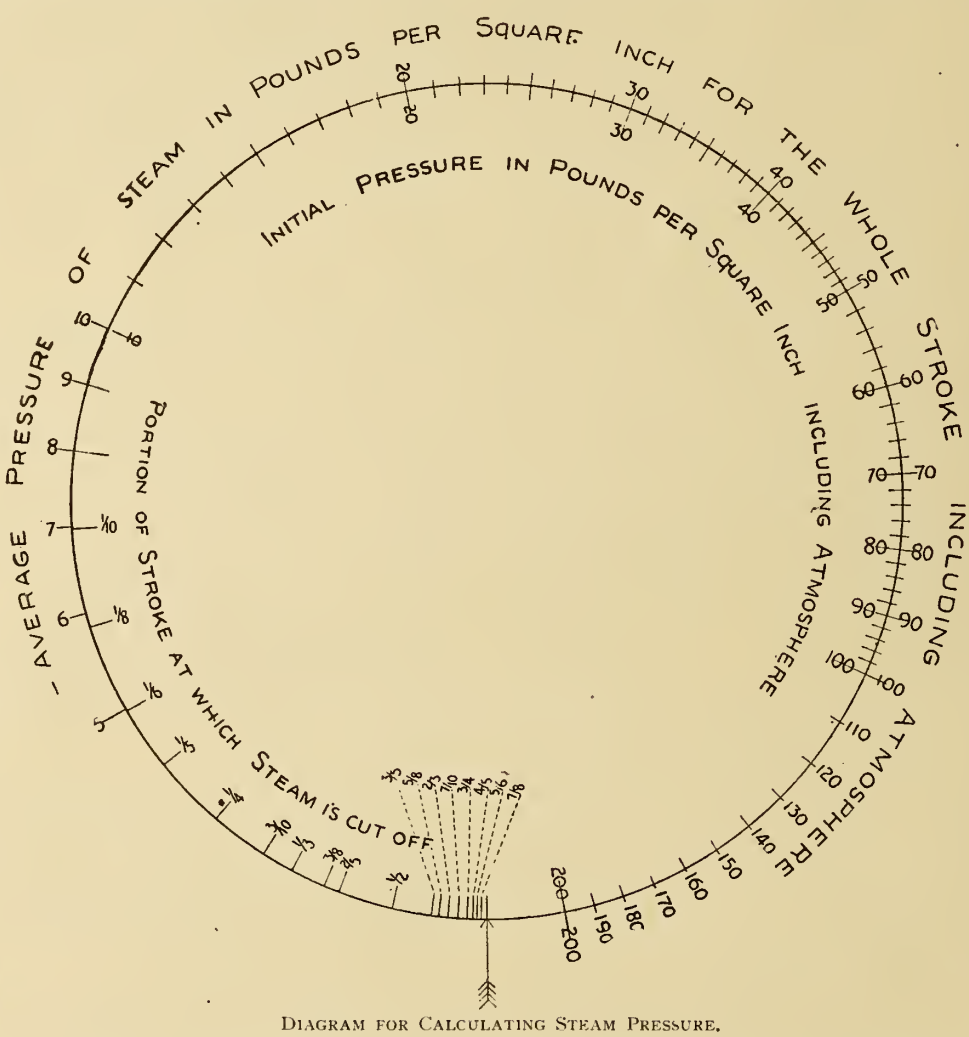


Diagram for Calculating Steam Pressure.

The diagram is not ready for use in its present form, as printed, however. To prepare it for use: Cut out the square space of blank paper on which the diagram appears, and mount it on a square piece of card-board. Then cut the central disk free very carefully, so that it may be an exact circle. Glue the outer part of the sheet to a second piece of card-board, and fasten the central disk to it by a pin passing exactly through its center so that it may be free to revolve within the outer part, and flush therewith.

When this is done, if any given ratio of expansion be set at the arrow, the diagram will show all possible combinations of initial and average pressure which can result from that ratio.

The diagram *N* indicator is based on the formula:

$$p = P\frac{(1+H)\times l}{L} \text{ or } = P\frac{1+H}{R}$$

where L = Length of stroke in inches.

l = Distance travelled by the piston before the steam is cut off.

R = Ratio of expansion $= \frac{L}{l}$

H = Hyperbolic logarithm of R.

P = Initial pressure of steam in pounds per square inch, including atmosphere.

p = mean pressure during stroke in pounds per square inch, including atmosphere.

This formula is solved by the diagram at a single setting for all possible values of any of the variables.

To find the mean pressure: Set the "portion of stroke at which steam is cut off" $(l \div L)$ on the disk, to the arrow on the indicator; then, coinciding with the "initial pressure of the steam" on the disk will be found the "mean pressure" on the indicator.

No allowance is made for imperfect vacuum.—*Engineering News.*

THE ENGINEERS' BILL.

By "Automatic Cut-off."

Mr. Tait's Bill before the Legislature for the licensing of engineers and the inspection of boilers seems to be meeting with some opposition. Nearly all the members think some kind of legislation would be advisable and acceptable to the people. The promoters of the Bill feel sure that a law such as that asked for by Mr. Tait would be satisfactory to steam users and engineers alike.

In support of the stand they have taken, they cite the instances of the several places where such laws are in vogue, and from all reports are accomplishing the objects for which they were passed. The Dominion marine laws have been in force for many years, and no explosions or loss have occurred. The steamboat owner has reaped the full benefit of the law, for he can engage an engineer to-day very nearly as cheap as he could before the law was passed, and any difference in wages is more than made up by the greater efficiency of the men.

In several of the states such laws have been in force, and the reports are all favorable. In North Dakota, last year, there were no explosions, against five the year before, killing eight and injuring nine persons. In this state all boilers come under the law, and there are several hundred threshing boilers and engines. In the state of Minnesota also, all boilers are under the Inspection Act, and all engineers must be licensed. The reports to the State Secretary show a clear record, and the steam user is satisfied with the change. All the larger cities have such laws; some of them have been in force several years, and all are satisfactory to employers and men alike.

The farmer and the saw mill man in the Ontario House are the strongest opponents of the Bill this year, and their avowed reason is that they will have to pay more money for engineers under the Act than without it. This the friends of the Act deny, claiming that it would not have that effect unless the Bill was so framed that it made of the engineers a close corporation, such as that composed of lawyers, doctors, or dentists. As the Bill does not do this, the matter of wages will still be regulated by supply and demand, and will not be influenced in any way by the Act.

More than half the number of explosions occurring in America are due to saw mill and agricultural boilers. The owners of such boilers are the most active in opposing the Bill.

It is more than probable that the result will be a permissive measure framed after the style of the Architects' Bill. This will have the effect of making a standard for engineers, and will go a long way to improve the efficiency of the men that apply under the Act for certificates.

PRIME CAUSES OF BOILER EXPLOSIONS.

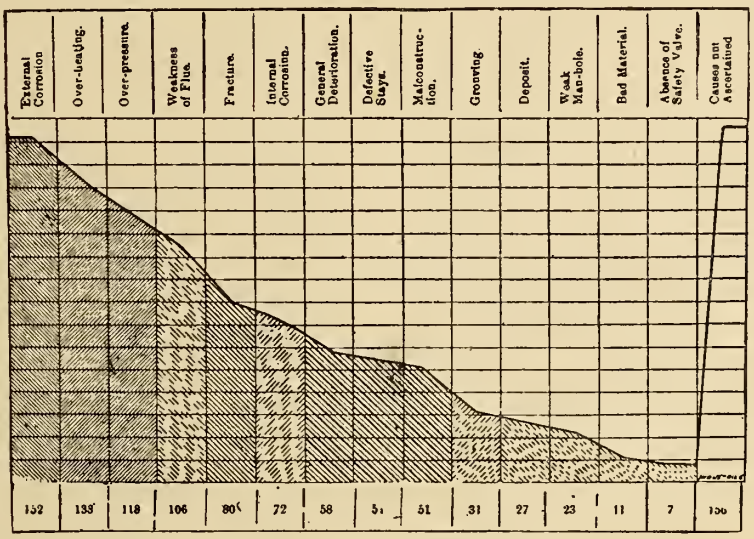
We are indebted to *Industries* for the diagram, which shows graphically the causes of boiler explosions, notably in the case of land boilers. This diagram is based upon an analysis of available reports of boiler explosions extending over a series of years.

The diagram was prepared by Mr. B. H. Thwaite for a lecture on steam generators, delivered weeks ago at the Yorkshire (Eng.,) College Textile Society. It reveals the fact, in a striking manner, that the causes are divisible into the following categories:—

1.—Through the influence of thermic action.
2.— " " " " chemical action.
3.— " " " " physical action.
4.— " " " " structural defects.
5.— " " " " defective supervision.

The diagram also shows clearly the necessity of using a form of steam generators not liable to corrosive effects, and points to the desirability of care being exercised in thoroughly draining the foundations of steam generators of the Lancashire and Cornish type, because by capillary attraction the water ascends through the flue walls until it reaches the shell plates of the boiler, and local corrosion is at once set up, which continues insidiously destroying the safety margin of the plates. The action is probably accelerated by the alternate effects of dampness and the contact of heated gases, resulting from the stoppage of the boilers each week end. This diagram might with advantage be placed in the hands of all those who are responsible for the safety of steam boilers.

We may add that it proves, still further, that the advantage of having boilers covered by assurance, and by a company which bases its insurance upon careful and frequent inspections, cannot wisely be gainsaid.



Number of Explosions from the Causes Enumerated Above.

ENGINEERING IN BRITISH COLUMBIA.

Victoria, B. C., April 18th, 1891.

Editor Electrical News.

Dear Sir,—Having read your article on the Quebec boiler explosion in the April number of your journal, it grieved me very much to see that the inspection of stationary boilers should have been entrusted to such an incapable man as the Quebec inspector is shown to have been, and that his incompetence should have led to such fatal results. But the object of my writing to you is to point out that in the Province of British Columbia we have no inspector for stationary boilers at all. Of all places this is certainly the one most in need of such an official, for the reason that labor being so high the cheapest man gets the job. The prevalent idea that occurs to steam users as to the qualifications necessary for a boiler and engine attendant, is, that he is able to shovel coal and oil the engine. As to the proportion or pressure of steam to be maintained, the rule is to keep as much of the latter as you can possibly get. To fill the responsible duties of the engineer's position a Chinaman in a number of cases is employed.

I remember on one occasion when working at a battery of six boilers which were fired by a Chinaman, that five of the safety valves were shored from the beams overhead to keep them down tight. This was but one of many such cases.

My reason for writing this letter is obvious; if the people but knew the danger which surrounds them, I think this evil would be remedied.

I not only think an inspector should be provided, but that boiler attendants should be compelled to pass an examination; and to accomplish this, would it be best for the Dominion or the Local Legislature to be asked to pass a Bill to this effect.

Thanking you in anticipation for the space in your valuable journal.

Yours truly,

Engineer.

[The Legislature of Ontario is now dealing with this question, and we presume the Local Legislature would be the proper body to remedy the unsatisfactory conditions existing in British Columbia.—Ed. E. News.]

The Montreal Water and Power Company has been incorporated with a capital of $2,000,000, for the purpose of constructing and operating water and electric systems throughout the Province of Quebec. Following are the names of the promoters: Messrs. Thomas Joseph Drummond, Alderman Prefontaine, Richard White, George Edward Drummond, James T. McCall, of Montreal; John F. Moffett, Watertown, N. Y.; Emil C. A. Waltmann, John Victor Clarke, George T. Keith, of New York; C. T. Moffett and H. Clarence Hodgkins, of Syracuse, N. Y.

THE ELECTRIC CIRCUIT.*

(Continued from April Number.)

Insulation.—Before proceeding to the practical details of the construction of the various apparatus in use, it will be advisable to devote a short space to the consideration of the most important of all points in connection with electrical engineering, viz., that of insulation. This is the rock that almost invariably wrecks the tyro in electrical matters, and more particularly even the man who, possessing but a slight knowledge of the science, fancies there is no mystery about it.

It will be remembered that it was stated at the beginning of the book that although bodies divided themselves roughly into three groups, which might be termed for convenience, conductors, semi-conductors, and insulators; yet the difference was only one of degree. All bodies conduct, all bodies offer some resistance; and whether a current passes or not, and what current passes, is decided by Ohm's law, no matter what the substance may be.

It has been already pointed out that a long length of fine wire offers a higher resistance than a river, for instance, though the wire is classed as good conductor, and water as a very bad one. It should also be noted that the conducting or insulating properties of *all* bodies vary with their physical condition. Thus dry cotton is a good insulator, wet cotton a very bad one. Dry glazed earthenware or glass are good insulators; the same with a film of moisture condensed on their surface are very bad insulators.

Further, the relative values of different substances as insulators vary with the E.M.F. opposed to them; and also, it must not be forgotten that the electrical resistance of the insulator *through* its substance follows the same law as to length and cross section as conductors, so that a substance which may insulate very well where only a small cross section is exposed to the E.M.F. present, may not do so if the section is large. As, for instance, in the case of two covered wires touching each other outside their covering; if they touch only at one point, the resistance of the insulating material—or the insulation resistance, as it is technically called—is high because the dimensions are small; but if the two wires are twisted, and lie together for some distance, the insulation resistance may be very much less.

A substance that will insulate perfectly in the presence of an E.M.F. of a few Volts, such as are used in telephone and electric bell work, may break down entirely under the strain, say, of 100 volts, the E.M.F. now used in most electric light work. And again, a substance that will answer for 100 volts, may break down under the strain of 2,000 volts, the E.M.F. which the Brush Cos. are using, and which apparently is to be used in town supply.

Again, in the choice of an insulator for any particular work, the electrolytic properties possessed by the current, and which have been already described, must not be overlooked, nor its ability to spark across short distances. A substance that may be a perfect insulator when new—if placed to separate two points or surfaces between which an E.M.F. exists—may gradually break down from the action of the current itself. Remembering, once more, that Ohm's law holds good here as elsewhere, whatever the fraction of an ampère of current may be which the law says shall pass; that current *will* pass, and will do work, and will probably alter the nature of the insulating substance, silently but surely; lowering the resistance of the insulator, till some mechanical action comes into play, such as the sharp edge of an iron plate, or a needle-point left in a casting, and either breaks the insulation down itself, or, by lessening the distance to the nearest point in the wire, provides the conditions necessary for a spark to pass, with practically the same result.

Again, the position of the points or surfaces that are to be insulated, with reference to the rest of the circuit, must be considered. Suppose a certain voltage, say 100 volts, to be present at the ends of the wires of the exciting shunt coils of a dynamo. Let the resistanee of the coils be 50 ohms, the current passing in them will be 2 ampères. Now, it will be apparent that we have the full 100 volts present only between the outer ends of the coils. Between the middle and one end we have 50 volts only, because from Ohm's law $E = C R$, $C = 2$ as before, and $R = 25$ ohms. $\therefore E = 50$ volts. So, if the field magnets have four legs each with 12·5 ohms resistance, the E.M.F., or difference of potential existing between the ends of the coils on either leg, is 25 volts only; and this is no question of theory, it may be proved by an actual test with an instrument called a voltmeter, to be described later, or by any of the methods described in the text-books. It is obvious that we may carry this matter as far as we like. Say that there are 25 layers of wire on each leg. Assuming that the wire is uniformly wound, each layer will have a resistance of ·5 ohm, and as the same current passes, *viz.*, 2 ampères, the E.M.F. between any coil and the one above or below it will be 1 volt. Further, if the layer consist of 20 turns, the resistance of each turn will be $= ·025$ ohm, and the voltage between any two adjacent turns at any point $= ·025 \times 2 = ·05$, or $\frac{1}{20}$ volt.

Thus it will be seen that the E.M.F., or difference of potential, usually present between many points which are in close proximity in coils and other apparatus is very small indeed; and therefore as long as the voltage and insulation remain the same all goes well; but should the insulation of any part be lowered, as by wet, oil, etc., by adjacent coils coming into contact, or by the deterioration of the insulator, the normal strain is increased. Thus, suppose that a quarter of the resistance of the coils of the dynamo magnets before referred to be cut out, say by the ends of the coils of one leg having come into contact with each other, so that the current passes across this path instead of round the coils. Assuming that our E.M.F. remains the same, we have now only 37·5 ohms opposed to the 100 volts and $\frac{100}{37·5} = 2·66$ ampères passing, instead of 2 ampères. Our voltage will now be in each leg, $12·5 \times 2·66 = 33·75$ v., instead of 25 volts, and the rest in proportion.

An increase of this magnitude on the present construction of dynamos would probably not be serious, the only thing that would happen being increased heating of the coils that were not cut, and an alteration in the lines of force. But suppose the above figures were multiplied by 20, and the short circuiting of a coil gave rise to an increased voltage of 250 V., between the ends of the coil of one leg, then the matter might be very serious indeed.

The substances used for insulating are, silk and cotton, in places where they will not become wet, as in coils of bells, telegraph and telephone apparatus, dynamos, motors, etc., where also the space available for insulation is small, and the covering cannot easily be subject to mechanical injury. In some cases the cotton or silk is further protected by a coating of some insulating varnish, such as shellac or india-rubber; but it is necessary to avoid all possibility of chemical action between the varnish and the wire, or between the varnish and the covering.

For wires which are exposed to moisture, or that have to stand a certain amount of rough usage, india-rubber, gutta-percha and Callender's pitch compound are used, generally in combination with wrappings or plaits of cotton and tape.

For wires that run overhead, as telephone and telegraph wires, no covering is needed, the air being the very best insulator obtainable, *when it is dry.* For these wires the rests are formed of highly glazed porcelain, or vitreous earthenware, made into special forms, so that the path from the wire to the iron bolt carrying the insulator is as long as possible, and of as small a cross section as possible. Ohm's law comes in again here. With telephone and telegraph apparatus the wire is connected to ground at each end, and a branch circuit will be formed to ground from the wire by way of each insulator and its support, be it a pole or the roof of a house. It will be obvious that the resistance of a single such leakage path will be very high; and that, provided the E.M.F. be low, the leakage current must be very small indeed; and so, on short lines, it usually is. But it will also be apparent that, as the length of the line increases, the number of these leakage paths will increase also, and the leakage current may be a very serious matter.

It is this which makes the problem of telephoning over very long distances so difficult in our humid climate.

Where the E.M.F. is high, as with high tension electric light circuits, the leakage from even a comparatively small number of rests may be serious; but at present the loss by leakage on high-tension electric light circuits carried overhead is inappreciable, because the lengths of the lines are so small. It will be seen later on that the insulation resistance of these electric light

* Walker's "Electricity in Homes and Workshops."

circuits should be kept up for another reason, viz., the safety of the public.

For the insulation of apparatus and parts of apparatus used in electrical engineering, various substances are used. Hard wood, when dry, is a very good insulator for many purposes; wet wood is a very bad insulator for any purpose. Thus, a ringing key at a colliery shaft bottom, if mounted on wood, may work perfectly at first, and fail after a time, owing to the wood becoming saturated with moisture.

Vulcanite—hard, black vulcanized india-rubber—is a first-rate insulator for nearly every purpose, and it does not readily absorb moisture; but it is brittle and expensive, and moisture will condense on its surface. It is unsurpassed for small collars, knobs, etc., designed to insulate two parts of an apparatus between which a high difference of potential exists, yet which must from the construction of the apparatus be close together.

Vulcanized fibre, another substance somewhat similar to vulcanite, is of great service in many places where the brittleness and expense of vulcanite forbid its use. It is tough, and, as its name implies, of a fibrous nature. Its one drawback is, that it absorbs moisture, and then its insulation resistance diminishes very considerably. It must not therefore be used where it will be exposed to damp or oil, except where only a low E.M.F. is present.

The flexible fibre is not a good insulator.

Mica and asbestos are also used for insulation chiefly on account of their non-combustible properties; but they can only be used in certain cases. Asbestos, when worked into mill-board, answers very well for many purposes, such as the insulation of commutator sections, coils of magnets, etc., always provided it can be arranged that the sheet shall not be torn; but it is not a perfect insulator.

The use of mica is more limited. Owing to its peculiar laminated character, you can have a plate of mica of a certain size as thin as you like, but it must be a plate of one thickness all through. It is not workable to section like other substances. It is somewhat brittle too, and it is doubtful if its insulating properties are as high as some people think. Slate and porcelain are now being used for the bases of electric light switches and fuzes; but the former is not a good insulator, and will not answer at all for high E.M.F.s; the latter has the disadvantage that it is difficult to work and is easily broken.

Once more, it must not be forgotten, that in the use of all these substances Ohm's law is the whole arbiter of the fittest, coupled, of course, with the law of dimensions and resistance. Thus, it may be quite practicable to use a comparatively poor insulator in the presence of a low E.M.F., especially if the insulation path is or can be made long and of small cross section, where it would not be if the conditions are reversed.

Induction.—A series of phenomena in connection with electricity that have a very important bearing upon the working of all electrical apparatus, are what are known as electrical induction, or electrical action at a distance.

It has been explained how electrical currents pass through conductors where continuity exists—where continuity does not exist, another series of actions takes place—induced electro-static charges are formed, and induced currents are generated.

When an electro-static charge is held upon a conductor completely isolated from other conductors, a charge of an opposite name is *induced* upon all other conductors in the neighborhood, that are not insulated.

Again, when a current of electricity passes round a piece of iron, magnetism is *induced* in the latteri, and will be rendered visible on closing the magnetic circuit.

When a permanent steel magnet is brought near a piece of iron or steel, magnetism is *induced* in the latter, provided it lies in the path of the magnetic circle.

But the most important phenomena of all are magneto-electric induction, and the induction of currents upon each other.

If a permanent or an electro-magnetic be brought into the neighborhood of a conductor, so that the latter lies at right angles, or nearly so, to the path of the magnetic circuit, or to the lines of force as it is usually expressed in the text-books, an E.M.F. is generated in the conductor, which will give rise to a current, if a path be open for it; and this generation takes place as long as the motion continues, or as long as an alteration in the field in the neighborhood of the conductor is going on. Thus, suddenly exciting an electro-magnet whose magnetic circuit crosses a conductor, will generate an E.M.F. in the latter. Suddenly causing an electro-magnet to lose its magnetism will have a similar effect; but the E.M.F. in the former case will be in the reverse direction to that in the latter; that is, it will tend to produce a current in the opposite direction through the electric conductor. Varying the strength of an electro-magnet will have the same effects, though in a minor degree, as suddenly magnetizing it or causing it to lose its magnetism.

Upon the phenomena of induction the dynamo-electric machine, the induction coil, and the transformer have been reared.

The property of inducing currents also extends to wires in the neighborhood of other wires. If, for instance, a second wire be wrapped round an electro-magnet, in addition to the exciting wire; each time that the exciting circuit is closed, an E.M.F. will be generated in the second wire; and each time the exciting circuit is broken, an E.M.F. will be generated in the second or secondary wire, as it is usually termed, the exciting wire being called the primary; but the direction of the E.M.F. generated in the two cases will be opposite to each other.

A variation in the strength of the current passing in the primary or exciting wire is also followed by a generation of E.M.F. in the secondary, though in a minor degree.

The directions of the secondary E.M.F.s are always such as to resist the action of the primary current. Thus, the current which passes in the secondary when the primary circuit is closed, is in the opposite direction to that passing in the primary; that which is generated in the secondary when the primary circuit is broken, is in the *same* direction as the current that was passing in the former.

Similarly, weakening the primary current generates a current in the secondary in the same direction as that which is passing in itself. Strengthening the primary has the reverse effect.

It is not necessary even for two wires to be together on an electro-magnet for induction to take place. Suddenly making or breaking the exciting circuit of an electro-magnet, generates opposing E.M.F.s within the coils of the exciting wire itself; that when it is made opposing the current, and that when it is broken assisting it. The latter has been known as the *extra* current, having been so named by Faraday, to whom we are indebted for so many researches upon electro-magnetic induction. It is the *extra* current that gives such a smart and often fatal shock, when the circuit of a high-tension electric light machine is broken; the coils on the field magnets of the dynamo generating, by induction, a very much higher E.M.F. than the working E.M.F. of the machine.

The secondary E.M.F. generated in all these cases depends upon the primary E.M.F., the number of coils taking part in the induction; or, what amounts to the same thing, the lengths of the wires exposed to induction; upon the speed of motion where one or both bodies move; and inversely upon the distance between the exciting and secondary apparatus.

It must be remembered, however, that in all these cases induction only takes place while motion is proceeding, or changes of magnetism are taking place, and the currents generated are therefore usually only of very short duration.

But it is not even necessary that iron should be present for induction to take place. If two wires be near each other and parallel; when a current passes in one, an E.M.F. is induced in the other at the moment the first starts and at the moment the first ceases; and these two are in opposite directions, and obey the same rule as before, viz., the secondary current is in the opposite direction to the primary, when the latter commences, and in the same direction as the primary when the latter ceases.

A variation in the current passing in one wire also gives rise to induced E.M.F.s in the other, just as in the case of the electro-magnet, with two wires wound on it.

The induction in the case of two wires also follows the same rule as to distance apart, and to the lengths of wire exposed to induction. The induction, for instance, between two telephone or telegraph wires running parallel for several miles, and within a few inches of each other, as on ordinary telegraph poles, will be very great; while that between wires separated by the width of a street, or only running together for a short distance, may be inappreciable.

The reason for E.M.F.s being generated in conductors under

the conditions named, is evidently due to their passing through the magnetic circuit, or, as it is usually termed, cutting the lines of force. Where an electro-magnet is excited, a magnetic field, a magnetic circuit, or magnetic lines of force, whichever term be preferred, is created; and the secondary wire lying in their path, an E.M.F. is generated in it. The converse takes place when the primary circuit is broken; and this applies to all cases of electro-magnetic induction. A magnetic circuit is either created, broken, or varied; and in each conductor lying in the path of the circuit, an E.M.F. is generated.

From the above it naturally follows, that in conductors which run parallel to the directions of lines of force, no E.M.F. is generated; and so it happens that no induction takes place between two wires crossing each other at right angles.

For effective induction, where the secondary current is to be used apart from primary; as in induction coils used for experimental purposes, for telephone transmitters, for the transformers now being introduced into electric lighting; the primary and secondary coils must be insulated from each other, and the insulation should be proportionate to the E.M.F.s generated. With induction coils, by wrapping a long length of secondary wire round a shorter length of primary, it is possible to generate very high E.M.F.s in the former, using only very low E.M.F.s in the latter; each coil of the secondary that is brought within the influence of the lines of force adding to the E.M.F.s generated. Where high E.M.F.s are generated, and used for the purposes of electric light distribution, being converted into low E.M.F.s at the point of consumption, great care must be taken to insulate fully between the coils, or the inductive action will be destroyed to a large extent, and may give rise to serious accidents.

But though, where it is desired to use electrical induction as a servant, it is necessary to insulate the two coils from each other, induction will take place nevertheless without any insulation. One case has been given, where the coils of an electro-magnet generate an E.M.F. by acting inductively on each other; coils even are not necessary for induction. But it will take place within a wire itself.

Each portion of a conductor acts as a separate wire. Thus, a copper rod half an inch in diameter may be taken to consist of a number of small wires all grouped round a centre; and as apparently the first action of a current is mainly confined to the surface of a conductor, induction takes place between the outer wires, so to speak, and the inner, giving rise to many puzzling phenomena in connection with dynamo construction, and with lightning discharges; about which something will probably be said later on, Prof. Oliver Lodge's recent investigations having considerably modified our ideas with regard to the latter.

ELECTRIC CRANES.*

By Reginald Bolton.

The use of hoisting machinery forms a subject of interest to many engineers, while the question of its economies is of even deeper interest to all those engaged in the transport or movement of materials. The application of electricity to this particular purpose is one that at first sight may not present great apparent advantage, but a consideration of the conditions to be fulfilled will, on the contrary, show that there is no more suitable conjunction of force and duty, and even at the present stage, no purchaser of hoisting machinery can afford to disregard the claims of the conveyance of power by electricity, for reasons which the author hopes, succintly, to show.

There are three considerations which present themselves, and which, if answered affirmatively, cover the whole subject.

Naturally, the primary one is,

1. Its comparative economy.

The second in order is,

2. Its superior merits.

The only remaining consideration being,

3. Its practicability.

Under the first we have to look into a few of the figures of electric and steam motors on cranes.

Now, an electric motor is in itself a most economical transmitter of power, its efficiency running as high as 90 per cent. in regular work, and if worked under proper conditions, its life may be as long as that of any ordinary steam engine, while under the special safeguards designed by the author its durability would be far more prolonged. But the power must necessarily be generated and conveyed to this motor, and so the question of the economy of the generating dynamo and the power that drives it comes into question. Such directly-connected engines and dynamos as are used on board ship, and in numerous central-station installations on land, have repeatedly given a united efficiency of over 80 per cent. of the horse-power of the steam in the cylinder.

There are a far greater number of cases, however, where such a dynamo would receive its motion direct from a shaft driven by a larger engine, and in such a case an even superior result might be relied upon. It would, in fact, be safe to assume an output of 85 per cent. of the actual power put on to the dynamo pulley, in the shape of electrical force, and as, in the case of shop cranes, or wharf cranes, they would not be remotely situated from the generating dynamo, the loss in transmission would be small and can be stated at 1 per cent. to 2 per cent. only.

In the case of a large dock, with cranes situated at all parts, there would be greater distances to be dealt with, but even these would not exceed the limits of ordinary low-tension circuits, and the system would show a very favorable comparison in losses by transmission, as against the distribution of hydraulic power.

For all ordinary conditions, then, we may deal with the following figures:

One h. p. put into dynamo results in	.85	of 1 h. p.
Less by loss in transmission two per cent	.00085	of "
Leaving the force put into motor as	.8415	of a h. p.
Output of motor 90 per cent. =	.7573	of 1 h. p.

Or a total loss of less than 25 per cent.

Now take the comparative case of a steam driven crane, say of two tons power, having two cylinders each 5½ in. diameter by 8 in. stroke, running at 150 revolutions per minute. Such engines are on full work linked up to cut off steam as late as ⅝ to ¾ of the stroke, and thus exhaust their steam at a considerable pressure. The usual boiler pressure is 70 lbs., maintained at an average of about 65 lbs., and wire drawn by pipes and connections to, say, 60 lbs. initial pressure. Under above conditions they indicate about 14½ horse-power, but their consumption of steam is very considerable, and cannot be assumed at less than 35 lbs. per horse-power per hour. An excellent authority gave, recently, instances of such small high-speed engines absorbing over 40 lbs. per horse power per hour. The net efficiency is still further reduced by the internal friction of the machines, which even in good engines would average 15 per cent., so that we arrive at a final efficiency of these engines used as motors on cranes of not more than 60 per cent.

On all small steam cranes, however, there is a further waste in the boilers, which, being small and of the vertical type, are far from economical in raising steam, and habitually consume 5 to 7 lbs. of fuel per horse-power per hour. In practice no crane is ever continually at work, and during the periods of lowering, changing gear and stops, &c., the fuel continues to burn, and there is also the cost of fuel and labor of raising steam in the morning for the day's work.

It is customary among crane builders to construct the boilers of steam cranes a good deal smaller than would be necessary if the engines were in constant running; the gain in pressure during the stops and changes mentioned compensating the loss of pressure during working, and the steam gauge is consequently constantly on the move. Now, against these figures we should have, in the case of a direct-driven dynamo, a better engine running with an earlier cut-off, and also necessary steam more economically raised. The motor when the crane is standing wastes no power, and the dynamo may be shut down or started at short notice. The crane driver need pay no attention to the crane when standing idle, and he starts without delay in the morning, the power being derived from the shop boilers. There would thus appear to be a very decided economy in favor of electric cranes, as against steam-driven machines. In the case of overhead travellers, there is the saving due to the absence of long square shafts running in movable bearings, and which, together with the cotton or wire ropes in rope-driven cranes, are kept constantly running even when the crane is out of use.

* Abstract of a Paper read before the Civil and Mechanical Engineers' Society, February 18, 1891.

Lines of force that have the same direction repel each other, while if they have opposite directions they attract each other.

NOTES.

A two-shell type of boiler is giving considerable promise under experiment in England, withstanding, so it is said, greatly increased pressure. This is a boiler recently designed to work with safety under a pressure of 250 pounds, consists of an inner shell capable of enduring 150, surrounded by a shell, the safe working pressure of which was 100. Reducing valves allow sufficient steam to pass from the inner boiler to the space between the shells to maintain the required pressure, and the inner shell is thus subjected to an unbalanced pressure of only 150 pounds, although containing steam at 250. Each compartment contains safety valves, and is carefully tested before using.

It is well known that vegetable and animal oils are unsuitable for cylinder lubrication. In an article on the subject in the *Portfeuille Economique des Machines*, M. Recour states that when colza oil was used on the railway with which he was connected, it was necessary to burn out the deposit in the ports of the locomotive cylinders after the engine had run 18,000 miles. At the end of a year's service this deposit was from .06 in. to .08 in. thick on the piston faces, and from 1-10 in. to ⅛ in. thick on the covers and steam ports. In the exhaust ports the thickness of deposit was as much as ·27 in. to ·35 in. On analysis the deposits proved to consist of carbonaceous matter from the decomposition of the oil, and of the oxides of iron and copper due to the wear of the valve and cylinder surfaces. When tested in the laboratory at temperatures 212° to 536° Fah., it was found that colza oil first absorbed oxygen, then gave off hydrogen, and finally broke up into olic and stearic acid with the separation of glycerine.

A cheap non-conducting coating for steam pipes, etc., said to have been used with perfect satisfaction by a Boulogne engineering firm, is described in a recent issue of the *Revue Industrielle*. It consists of a mixture of wood sawdust with common starch, used in a state of thick paste. If the surfaces to be covered are well cleaned from all trace of grease, the adherence of the paste is perfect for either cast or wrought iron; and a thickness of 25 m m. will produce the same effect as that of the most costly non-conductors. For copper pipes there should be used a priming coat or two of potter's clay, mixed thin with water and laid on with a brush. The sawdust is sifted to remove too large pieces, and mixed with very thin starch. A mixture of two-thirds of wheat starch with one-third of rye starch is the best for this purpose. It is common practice to wind string spirally round the pipes to be treated, keeping the spirals one centimeter apart to secure adhesion for the first coat which is about 5 m m. thick. When this is set, a second and third coat are successfully applied, and so on until required thickness is attained. When it is all dry, two or three coats of coal tar, applied with a brush, will protect it from the weather.

There are a great many people using incandescent lamps, says *Modern Light and Heat*, who are wont to complain that the lamps are not satisfactory in their operation; they burn too few hours, or do not give light enough, or the globe soon becomes blackened. Such are some of the objections put forth, and which to our knowledge, in several cases, have caused a change in the make of a lamp, which has given no better results, simply because the fault to a certain extent has been with the user and not with the lamp itself. There is nothing which kills a lamp quicker than operating it at too high a voltage, and owners of isolated plants are often prone to do this. It is, moreover, poor economy; for if more light is required, it would be cheaper in the long run to install more lamps and run them at the proper voltage. We have seen installations, too, where dust and dirt were both too familiar friends with the incandescent lamp and where improper shades were absorbing twenty per cent. of the light. If users of incandescent lamps would first run their lamps at a proper voltage, and then see that the glass is kept perfectly clean and free from dust and dirt, and that they are supplied with proper shades, there will be better results and less cause for complaint.

The Edmonton *Bulletin* thus refers to deposits of platinum existing in the Saskatchewan district in the Canadian Northwest: The price of platinum has risen steadily during the past few years, especially since the advent of the electric light, in the production of which it is found to be an absolute necessity. The market price in London is now $20 an ounce. In each 16 candle power light there are from four to eight grains of platinum. If six grains are taken as an average an ounce will be used in eighty lamps. Based on the increased use of incandescent lights within the last two years it is safe to say that the demand for 16 candle power lamps or their equivalent in the present year will reach 10,000,000. This means a demand for 125,000 ounces of platinum, worth at the present price over $2,000,000. The supply is mostly drawn from mines in the Ural Mountains of Russia. Platinum is found in the Saskatchewan in connection with gold, with which it is frequently secured and sometimes adulterated. At present prices it would pay our miners to give more attention to this increasingly valuable metal, not only as a matter of present profit, but also with a view of the possibility that although the fountain head of the gold has as yet eluded discovery, the platinum might lead to the source of both these now equally precious metals.

A. ALLAN, President. J. O. GRAVEL, Sec.-Treas. F. SCHOLES, Managing-Director.

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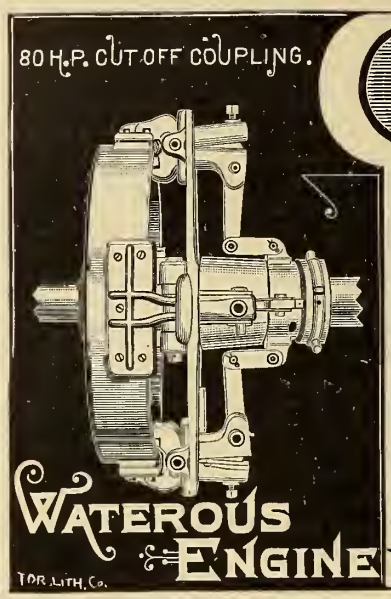
J. H. WALKER, Manager.

Many suggestions have been made for remedying the vibration and noise attendant on the working of the big engines which are employed to run dynamos. A plan which has given great satisfaction is to build hair felt into the foundations of the engine. An electric company has just had one of its ninety horse power engines removed from its foundations, which were then taken up to the depth of four feet. A layer of felt five inches thick was then placed on the foundations and run up two feet on all sides, and on the top of this the brickwork was built up. The cost of the alterations was about $300.

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SPARKS.

A single line of force, or unit, is that amount of magnetism which passes through every square centimetre of cross section of a magnetic field whose intensity is unity.

The Belleville gas company's works and electric plant have been leased for ten years by Mr. Pearson, of Toronto, who is to pay 6 per cent. on the capital of $80,000 and 6½ per cent. on a mortgage of about $40,000.

The volts in the shunt dynamo fall, whilst those in the series rise as the current rises. By employing compound winding, the mean of the two effects is obtained, and the volts can be kept practically constant over a wide range, without change of speed.

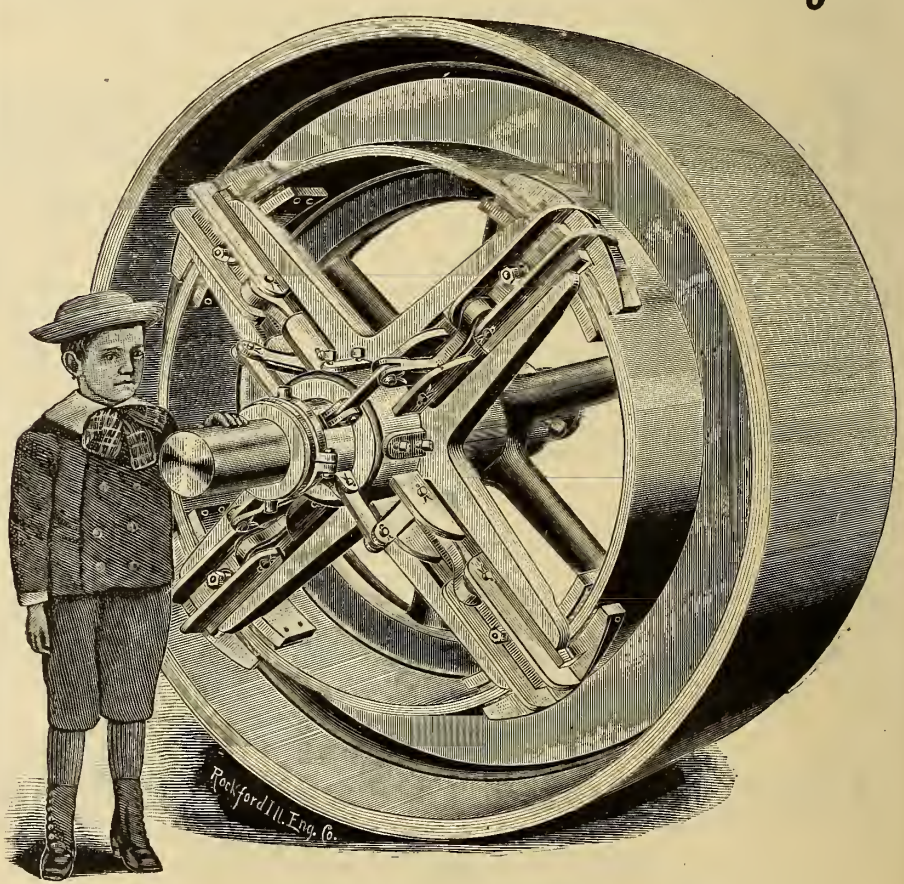
The Ottawa Electric Street Railway Co. has been organized as follows: President, J. W. McRae; vice-president, Geo. P. Brophy; treasurer, Wm. Scott; secretary, D. C. Dewar. The secretary reports that about three-fourths of the stock of the company has been subscribed.

Mr. Mackintosh, M. P., is at the head of an Ottawa syndicate which is seeking incorporation under the name of the "Anglo-Canadian Electric Storage and Supply Co.," for the purpose of manufacturing, selling and leasing secondary batteries and all kinds of electric supplies and appliances.

The business and plant of the Hamilton Electric Light Co. was purchased at auction on the 19th inst., by Toronto and Hamilton capitalists for the sum of $92,000. The Toronto members of the new company are directors of the Toronto Electric Light Co. The Hamilton members are Messrs. J. M. Lottridge, R. Æ. Kennedy, J. V. Teetzel, Robert Thomson and D. R. Dewey. It is stated that $50,000 will be spent in improving the service and establishing an elaborate incandescent lighting system.

In interior wiring for incandescent lamps, particular attention should be paid to fuse boxes, and especially to the quality of the fuse wire. This is made of such varying composition that scarcely two makes act in a similar manner. Some samples possess good conductivity and are slow in heating, while others fuse readily, not only causing the annoyance of frequent replacement, but offering the temptation to careless workmen to use too heavy a fuse wire or substitute copper wire,—a most pernicious practice and destroying at once the protective properties of the fuse box. —*Modern Light and Heat.*

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SPARKS.

The Fort Wayne Electric Co. has been given the contract for lighting the city of St. Thomas.

A Bill has passed the Legislature enlarging the powers of the Mimico Electric Railway and Light Co.

Dr. Knight has been delivering a series of instructive lectures on electricity at the night school classes for workingmen at Kingston, Ont.

The Perth Electric Light Co. have purchased a 540 light incandescent plant, and will in future operate both arc and incandescent systems.

At the Government printing bureau at Ottawa there has lately been installed an incandescent plant supplying 1,100 lights. This is the largest isolated incandescent plant in the Dominion.

The Port Hope Electric Co. have been unfortunate by reason of the occurrence of several accidents on their premises. It is gratifying to learn, however, that affairs are now running smoothly with them.

The St. Catharines Electric Street Railway, owing to the financial embarrassment of the proprietor, has passed under the control of the Bank of Toronto, and is being operated under the management of Mr. Thos. Nihas.

In the Bill authorizing the amalgamation of the Kingston gas and electric companies, the charter of the new concern has been limited to twenty years, at the end of which period the city is given the privilege of acquiring the plant.

The manager of the Hamilton Electric Light Co. states that the manufacturers of electric globes in Canada charge 50 per cent. higher prices than those prevailing in the United States; consequently American globes are being purchased.

Toronto Central Division No. 123, of the order of Railway Telegraphers, was organized a few weeks ago with the object of raising the standard of the profession. Delegates were appointed to attend the annual convention of the order at St. Louis, in June.

The Bell Telephone Co.'s new building at Hamilton is to be ready for occupation early in July. It will contain a new multiple switchboard capable of accommodating 3,000 subscribers. It is said to be the intention to reduce the present rates to small consumers.

A Pembroke lunatic started out to shoot a citizen of that town the other day for the alleged offence of exercising undue influence upon him by means of a galvanic battery or other electric apparatus. The would-be murderer was "switched off" to the county jail.

Mr. A. E. Elliott has succeeded Mr. Geo. E. Bander as manager of the electric street railway at Vancouver, B.C. The retiring manager, prior to leaving for Seattle to enter upon the duties of a new position, was presented with an easy chair, scarf pin and complimentary address by the employees of the company.

Mr. Tait has introduced a measure in the Ontario Legislature authorizing municipal councils to compel telephone, telegraph, electric light and other corporations stringing overhead wires to place their wires in cables; also to compel such companies to allow other wires to be strung on their poles, subject to payment of a reasonable rent, such rent, in the event of dispute, to be fixed by an electrical expert to be appointed by the Commissioner of Public Works.

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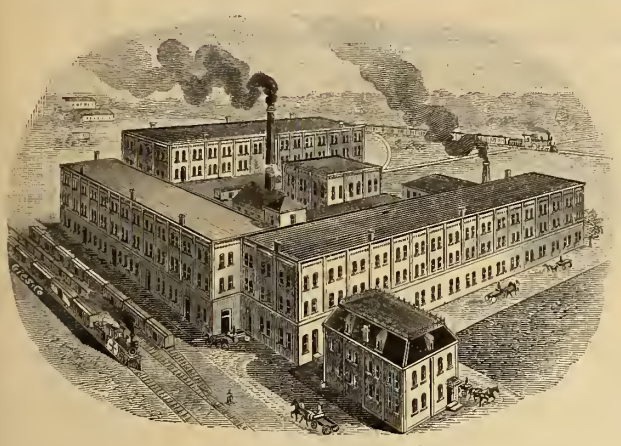
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WORKS AT FORT WAYNE, IND.

References in Canada:

Halifax Gas & Electric Light Co., Halifax, N.S.

New Glasgow, Nova Scotia.

The New Brunswick Electric Light & Power Co., St. John, N.B.

Electric Light & Power Co., Woodstock, Ont.

W. H. Comstock, Brockville, Ont.

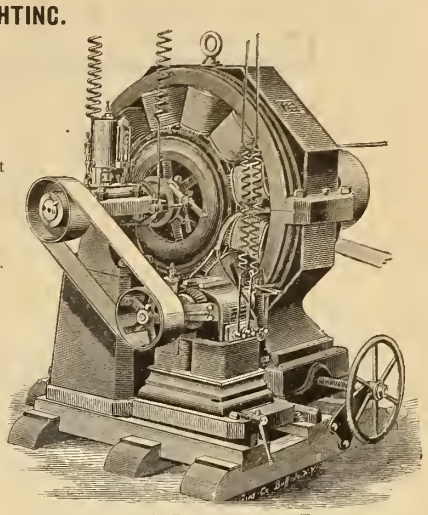
Electric Light & Power Co., Port Hope, Ont.

Electric Light & Power Co., Cobourg, Ont.

Corporation of Collingwood, Collingwood, Ont.

Niagara Falls Electric Light & Power Co., Niagara Falls, Ont.

Kingston Electric Light Co., Kingston, Ont.



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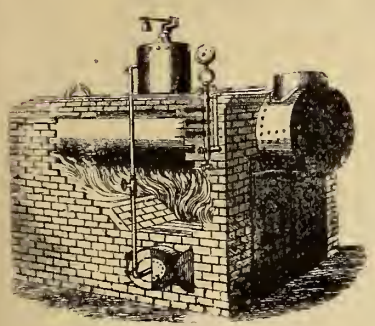
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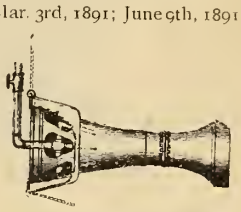
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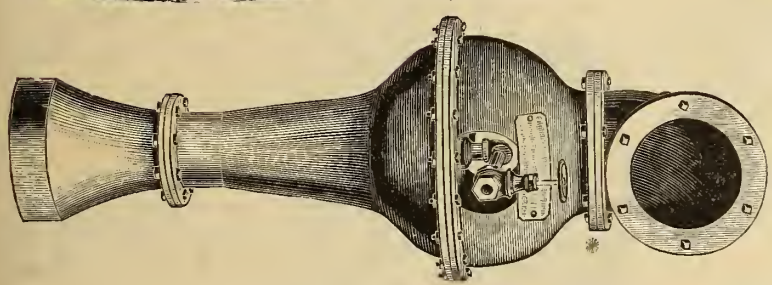
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CANADIAN PATENTS:
Oct. 20th, 1890; Nov. 20th, 1890; Feb. 2nd, 1891.
U. S. PATENTS:
Mar. 3rd, 1891; June 9th, 1891.





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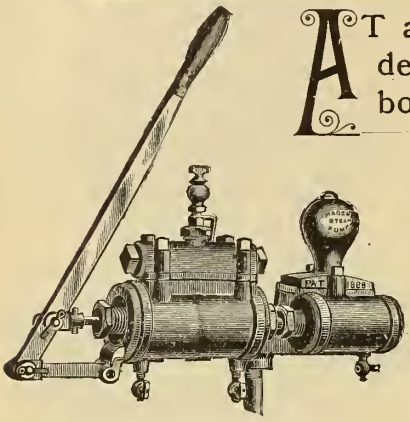
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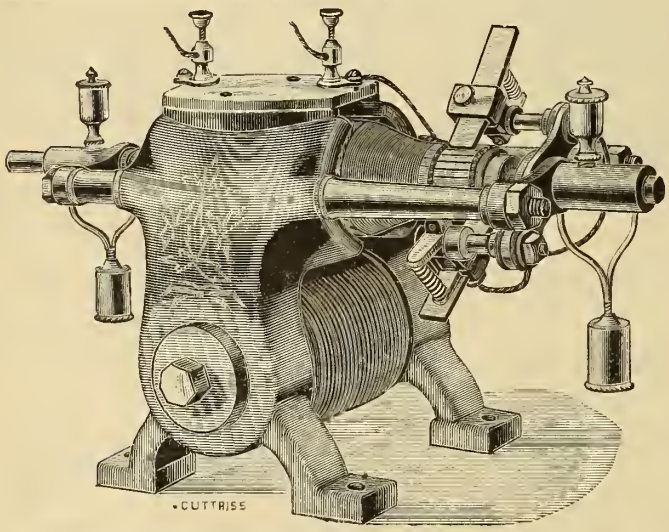
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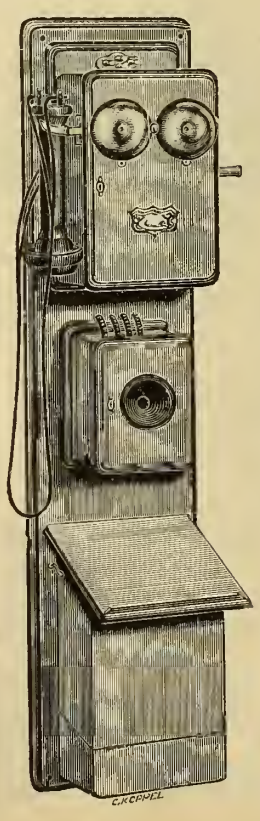
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STEAM ENGINEERING JOURNAL.

VOL. I. TORONTO AND MONTREAL, CANADA, JUNE, 1891. No. 6.

S. R. EARLE'S AIR AND STEAM INJECTORS.

THIS device, invented by Mr. S. R. Earle, of Belleville, Ont., is for the better combustion of fuel in furnaces connected with steam boilers, enabling any one to use a cheap grade of fuel such as waste coal, hard and soft coal screenings, tan bark, saw dust, &c. It takes the place of fans for creating a forced draught, using, it is claimed, a much smaller amount of steam, and is very desirable in any place where the draught is poor. It will also be found advantageous where even the best fuel is used, but is especially adapted to burn hard coal screenings, maintaining as strong a blast as desired. The injector is built in the wall of the furnace, the nozzle passing underneath the grate bars. The ash chamber having been made tight, the air and steam is compressed in the ash chamber, the commingled air and steam passing through the ignited fuel, the steam being converted into hydrogen gas. This mingled with the air is the hottest fuel known. The steam is not lost as applied in operating fans, but is turned into fuel after creating the blast.

The air injector (Fig. 2) shows the device as applied to the side wall of a furnace, this circumstance being an exceedingly convenient feature of its application and necessitates no structural change of any furnace to which it may be applied, and it is entirely out of the way. The device consists of a tapering section of an injecting tube having a straight portion or neck at the smaller end, preferably, an outward peripheral flange, to which is connected a flaring, round, oval, or elliptical tubular discharge section, having, preferably, a flange, which is bolted to a flange to allow the straight outlet to be removed and an elbow section having a flaring mouth substituted to adapt the injector to suit marine and locomotive boilers. The larger end of the tapering section of the injecting tube is closed by a cap. A series of perforations are made in the periphery of the tapering section, near the larger end, to admit air into the injector. The injector is preferably of oval or elliptical shape in cross section throughout its length to obtain better distribution of the commingled air and steam, especially in furnaces of large size. A steam pipe enters the tube through the outer or closed end, terminating with a series of branches, each having a small orifice to discharge a small jet of steam into the injector longitudinally, and the branches extend past the series of perforations and cause an induced current or indraft of air, which becomes incorporated with the steam to assist combustion while passing through the fuel. The noise caused by the discharge of a considerable jet of steam against the air in the injector is greatly moderated by smaller steam jets more or less distributed. A bell shaped hood surrounds the larger end of the tubular section and peripherally incloses the series of air perforations. The open end of this hood projects beyond the larger end of the injector and is provided with doors, closing over the end cap, the hood, when the doors are closed, preventing direct indraft through the perforations, to economize fuel when the fire is banked or slow combustion desired after the steam valve has been closed. The middle portion of the injector is embedded in the wall of the furnace below the bars. The commingled steam and air discharged from the injector pass up between the furnace bars and through the fuel to promote combustion. The perforated portion of the injector projects from the outer face of the wall of the furnace to allow air to freely enter the perforations, and by embedding the middle portion of the injector in the wall of the furnace the noise of the steam and air passing through the injector is lessened, and an objectionable feature thereby removed. This is one of the simplest as well as the most satisfactory injectors of its class yet designed.

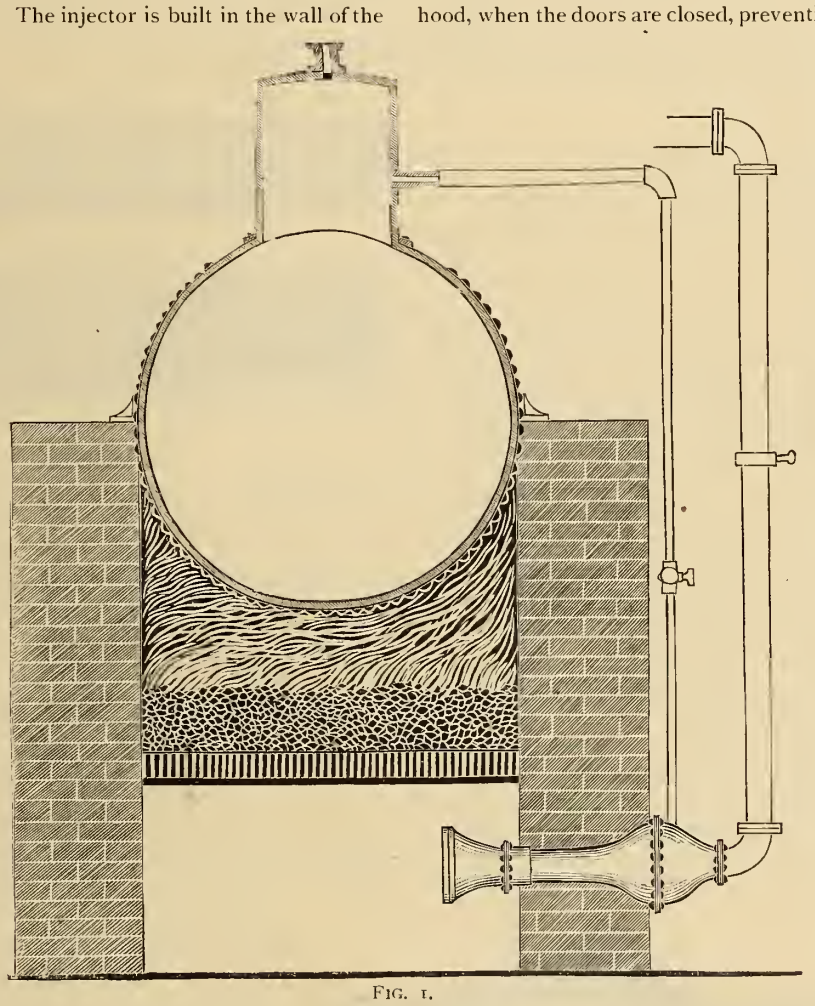


FIG. 1.

Fig. 3 is the combined air injector and exhauster, and will do all that the air injector will, and in addition will exhaust the gases from mines, ventilate ships, buildings, etc. This machine is practically noiseless when applied as shown in Fig. 1.

These machines have been in successful operation for some months, and are now working boilers, driving electric light plants and other machinery, also operating gas-producer cupolas, one of which may be seen working at the Consumers' Gas Company, Toronto, Ont.

Fig. 4 is the grate bar used in burning hard coal screenings, sawdust, tanbark, or any fine fuel.

The town of Port Arthur invites tenders until the 15th inst. for the purchase of $75,000 of debentures. The money realized is intended to be expended in building, equipping and operating an electric street railway.

NUMBERING AND RECORDING ARC LAMPS AND LOOPS.

By W. H. Markland.

Some time ago I inaugurated a system of numbering and recording arc lamps which has worked well in practice and may be of assistance to others.

My plan briefly is as follows: The dynamos are lettered "A," "B," "C," &c., and the loops, or lamp circuits, are numbered 1, 2, 3, &c.

In numbering the position of lamps, be they hanger board or

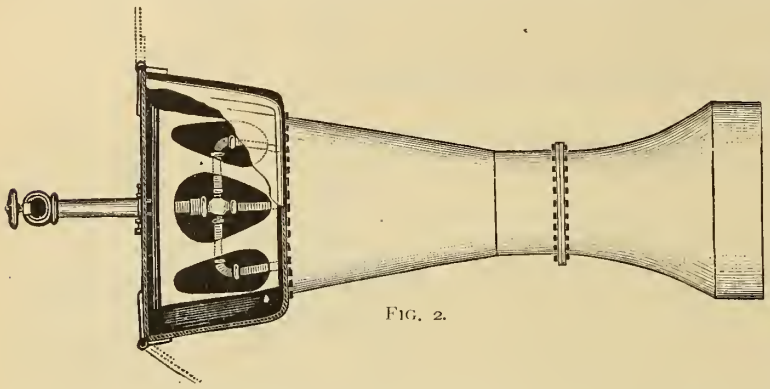


Fig. 2.

pole inside or out, the number of loop or circuit is indicated by numbers to the left of a decimal point, and the number of lamps starting out on the positive wire by numbers to the right of the decimal point, thus: the first lamp on loop one would be marked 1.01, the next 1.02, &c. The first lamp on loop 2 would be marked 2.01, the tenth lamp 2.10, the twentieth 2.20, &c. On loop 12, the first lamp is marked 12.01, the tenth lamp, 12.10, &c.

As before mentioned the number to the left of the decimal point indicates the number of the loop, and that to the right the number of the lamp. This plan, as can readily be seen, is easily remembered. A person familiar with the loops can tell the number of any particular position of a lamp by simply counting the lamps on the loops.

If additional lamps are put up they can be given a higher number than those on the loop; or, if only a few intermediate lamps are added they can be numbered with a third number to the right of the decimal; thus, if two lamps are put on loop one between 1.01 and 1.02, they could be numbered 1.011 and 1.012. The men would readily remember these numbers as they are different from the regular run. When a loop gets too badly mixed up it is a short job to renumber.

A tin tag having a number painted on it is nailed to the lamp board or the pole. Where the poles or hanger boards are numbered from one up, without reference to loops, it is difficult to remember on which loop the lamps are run, the number not indicating the loops. By this plan the loop number is always known. Trimmers notice the numbers while trimming and become familiar with them very readily.

I consider it is very much better to number loops than to name them, it being much easier to tell the dynamo man to put on loop 1 at 6 p. m., than to say "Put on Jersey Swamp loop at 6 p. m."

In the dynamo room a sign is posted, giving the number of the loops, where they go, and the number of lamps on each.

The trimmers and inspectors in making out reports of lamps

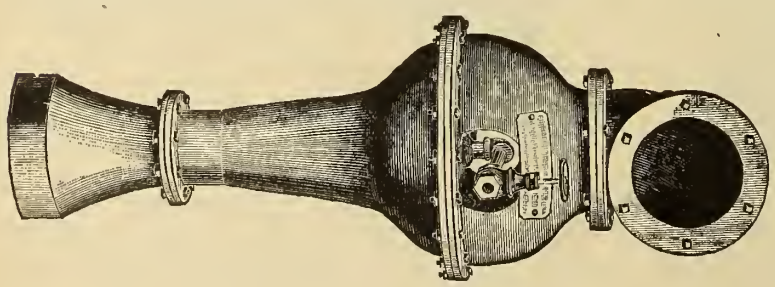


Fig. 3.

simply report lamps of such a number as giving trouble. The blanks for inspector's reports are made out as follows:

"S"—Started Lamp No. ——
"U"—Unable to Start Lamp No. ——
"A"—Adjusted or Repaired Lamp No. ——
"R"—Renewed Lamp No. ——
"G"—Globe put on Lamp No. ——

In the log book, which need be nothing but a common blank book or ledger, a line is used for each lamp. When anything goes wrong a record of it is made thus: Suppose on March 14, 1891, the inspector reports it necessary to start lamp 1.08. On the line for that number would appear "1.08 S, 3/14/91,"—the letter "S" indicating what was wrong and followed by the date. If three days later the lamp would not burn, the record would appear thus: "1.08 S, 3/14/91. U. 3/17/91;" if afterward the lamp was adjusted or repaired the entry would read: "1.08 S, 3/14/91. U. 3/17/91. A. 3/17/91." If it is necessary to replace it with a new or repaired lamp, this would be the record: "1.08 S, 3/14/91. U. 3/17/91. A. 3/21/91. R. 3/24/91;" or if a globe was put on, a "G" before the date would be used to indicate what was done to that lamp.

In the same book a record of each lamp should be kept giving the number, position, kind of lamp, how hung, and the date put in service; also a route diagram giving the run of the wires, their position on the poles and to which lamps they go. A trouble report of dynamos, &c., should also be kept. One very important point is to date everything entered.

This plan, as can readily be seen, takes but little space in a book, and gives clear and accurate information. At a glance it is possible to tell where the difficult places to maintain arc lamps are.

This plan can be further extended if desired, by putting the maker's number of the lamp under the year. A lamp when repaired should be as good as new.

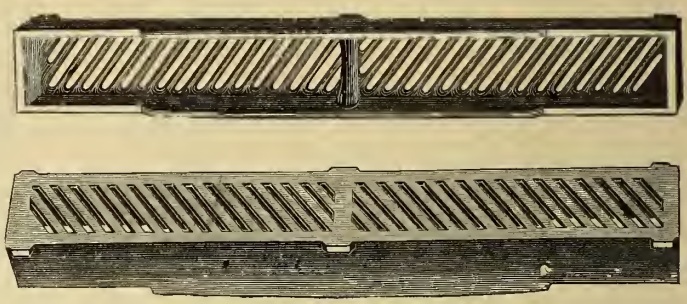


Fig. 4.

A very simple manner of telling the cost of running arc lamps is as follows:

HOURLY RECORD OF ARC LAMPS, MARCH, 1891.

Loops	Dates	1	2	3	4	5	6	7	8	9	10 etc.	Total Hours for Loop	Lamps	Total Lamp Hours
1														
2														
3														
4														

By entering every day the number of hours a loop was in use, and at the end of the month adding these hours together and multiplying by the number of lamps on the loop, total hours for one lamp is obtained. By adding together the total or lamp hours for all the loops, and dividing that into the cost of running the plant, the cost an hour per lamp is readily obtained. This gives one of the very best of records.—*Electrical Age.*

The first electrical power in the province of Wurtemberg has just been put into operation in Konigshbronu, where steam power has been replaced by electric power in the Royal Foundry. The installation has been carried out by the Esslingen Engineering Works. Until recently the strong source of the Brenztopf was used only in connection with a forge situated in dilapidated buildings. These have now been demolished and a small house built in their place at the side of the source. It contains a turbine which drives a dynamo at 600 revolutions per minute, and which gives 40 electrical horse power. The current from this dynamo is transmitted by means of overhead conductors across the town to the Royal Foundry, where 25 turning lathes and polishing machines are actuated by electro-motors. Suitable regulating appliances have been provided, so that should variations take place in the quantity of water of the Brenztopf, the power transmitted shall remain constant.

THE H. P. OF ENGINES.

TORONTO, May 11th, 1891.

Editor ELECTRICAL NEWS.

SIR,—I see by Mr. D. W. Ross' letter in the last issue of the ELECTRICAL NEWS that he is still off on the H. P. of engines. I think Mr. Ross must have got the old rule for finding the nominal H. P. of engines somewhat mixed up with the rule for finding actual H. P. The rule adopted by the Admiralty to determine the N. H. P. of engines is based on an effective steam pressure of 7 lbs. per sq. inch with a piston travel of 220 ft. per minute, but I do not think this 220 ft. has anything to do with the rule for finding the actual H. P.

I had the pleasure of listening to Mr. J. Galt's lecture in the Free Library on "The Mechanical Principles of Work," and I must say that he made everything appertaining to his subject very plain indeed (to me at all events, and I am only a practical engineer, not an M. E. or C. E., though I wish I was). Friend Ross was there also, and he did not seem satisfied on this H. P. business, hence the discussion. Mr. Ross gives formula for finding H. P. of engine as follows: $\frac{A \times P \times S}{33{,}000 \times 220} = \text{H. P.}$ This is all right until he comes to multiply by 220. The correct formula is $\frac{A \times P \times S}{33{,}000} = \text{H. P.}$ All we require in this formula is the speed in feet per minute the piston is travelling, in order to find how many times 33,000 lbs. is raised 1 foot in 1 minute. There is no need for multiplying by the speed that any horse travels. I would like to ask Mr. Ross, if he were to indicate an engine and figure out the card, would he use his formula to do so, and if so, does he think he would be correct? I know this much, *i. e.*, if he thinks he would be correct, he is about the only man (engineer) in Canada who would think so.

Friend Ross, says: "We are all differently constructed, think, see, feel, &c., differently, and have different opinions." Well, I should say so! It would be a queer world if we did not. Any way, I'll wager anything that there is not an engineer in Canada but will differ from Mr. Ross on this question of H. P. of engines. Mr. Ross must get himself properly counter-balanced before he can act as an automatic governor to Mr. J. Galt, as I am afraid from present indications that his regulation is not perfect.

Any way the discussion will do no harm, and may put friend Ross on terra firma.

Yours respectfully,

"SAFETY."
(Practical Engineer.)

Editor ELECTRICAL NEWS.

DEAR SIR: In your last issue I see a letter from D. W. Ross, C. & M. E., in which he seems to have got somewhat mixed in his ideas of applying the foot pound to the h. p. of an engine. I had the pleasure of attending Mr. Galt's lecture in which he made the statements Mr. Ross has taken exception to. I thought Mr. Galt made the application of the foot pound, as used to measure power, quite plain—at least it seemed so to me. The formula that Mr. Ross has constructed to demonstrate what 1 h. p. is, seems far-fetched, and is not correctly stated. Taking his statement and writing it correctly, using the h.p. of steam engine for numerator and the power of a horse for the denominator, we would have:

$$\frac{33{,}000 \text{ lbs.} \times 1 \text{ foot} \times 1 \text{ minute}}{33{,}000 \text{ lbs.} \times 1 \text{ foot} \times 1 \text{ minute}} = 1 \text{ h. p.}$$

That is, either the numerator or the denominator would equal 1 h. p.

If Mr. Ross wants to move the load faster than one foot in one minute, we can do so, and by reducing the number of pounds raised, increase the speed, still having the same result in work done, viz., 330 lbs. × 100 ft. × 1 minute = 1 h. p. If we raise 33,000 pounds 1 foot high per minute we have a horse power. If we raise 330 pounds 100 feet high per minute, we exert the same amount of power.

In steam engine practice we use a piston speed of say 600 ft. per minute. Now the value of 1 pound of steam pressure on a piston containing 110 square inches area would be $\frac{600 \times 110 \times 1}{33{,}000 \times 1}$ = 2 h. p.; and if the speed of the piston was only 300 feet per minute, it would be $\frac{300 \times 110 \times 1}{33{,}000 \times 1} = 1$ h. p.

I cannot find anything in "The Mechanic's Own Book," Rankine's "Manual of the Steam Engine," Roper's "Marine and Land Engines," Reid's "Engineer's Hand-Book," or any other mechanical publication that tells me I must multiply 33,000 by 220 to get a h. p.

I am very sorry that I cannot write C. and M. E. after my name, but I hope this will assist Mr. Ross to see the h. p. of an engine in its correct light.

N. GINERE.

TORONTO, May 25th, 1891.

Editor ELECTRICAL NEWS.

DEAR SIR,—I am getting mixed somewhat regarding the horse power of an engine. If Mr. Ross is right, I am wrong. I am running an engine 10" x 28", revolutions 90, steam 85 lbs. The indicator man says I have 32 lbs. mean effective pressure. The diameter of my cylinder area = 78·54 and 90 revolutions = 420 feet. The formula is:

$$\frac{10^2 \times .7854 = 78.54 \times 420 \times 32}{\text{H.P.} = 33{,}000 = 31{\cdot}9168 \text{ H.P.}}$$

Our engine was sold to us for 35 H. P., and I am of the opinion that it is capable of doing 10 H.P. more than we are doing at present if speeded up some. I am at a loss to know the reason that Mr. Ross multiplies by 220, for in his formula it is thus:

$$\frac{10^2 \times 78{\cdot}54 = 78{\cdot}50 \times 420 \times 32}{33000 \times 220 = 726000 = {\cdot}1453}$$

nearly 7·16 of a H.P. I cannot understand it. I want to be right. Will Mr. Ross please explain? I should be most happy to meet him any evening he could conveniently appoint, in order that I might be put right, or that I might put him right.

ONE WHO WANTS TO BE RIGHT.

QUESTIONS AND ANSWERS.

"W. H. K." writes: I have a common plunger pump as a feed pump, and it is pumping cold water through a National feed water heater. The size of plunger is 3", stroke 8", suction and discharge pipes 1½", suction lift about 10 feet, with a horizontal distance of 200 feet to the water. The pump valves are new and in good order. Our trouble is, that the pump pounds so badly that the valves soon give out, besides making a very disagreeable noise that is heard all over the factory. I would like to know the cause and remedy for this, if there is one.

ANS.—You do not state the speed of the pump, but supposing the speed is 60 strokes per minute, your 1½" column of water would have a speed of 40 feet per minute. Now this body of water must be started and stopped 60 times each minute, and will most likely cause the pounding you complain of. Put an air chamber in the suction pipe close to the pump valves and you will get over the trouble; you can make one by putting a T in the suction pipe, say with a 2" central hole, then screw a piece of 2" pipe, standing perpendicular, into it. Make it about 5 feet long and put a cap on the top of it.

Will the judges in your recent competition for engineers show through your paper how they get at the amount of fuel saved in question No. 9? Mr. Edkins' answer is 55 lbs; Mr. Mooring says 8%. If they will show how to work these two problems out, they will very much oblige

MEMBER C. A. S. E.

"ENGINEER," Toronto, writes: Will you please answer the following questiont hrough the columns of your valuable paper: I have a back pressure valve, 6" diameter, with a spindle through centre on which it swings, and a lever 24" long keyed to spindle. On the end of lever is a 40-lb. ball. What pressure would be required under the valve to raise it? Please give formula for this, and oblige.

ANS.—There seems to be something wrong with your description of the construction of your valve. You say it is 6" diameter and swings on a spindle through centre. If it swings on a spindle passing through the centre, there will be as much pressure on one side of the spindle as on the other, and being thus balanced, the pressure will neither open it nor close it. Better give a fuller description of the inside arrangement, and we will try and answer your question.

A charter has been applied for by parties desirous of operating electric light in Kentville, Nova Scotia.

MAGNETISM.*

MAGNETISM and electricity are very closely allied, each being more easily converted into the other than into any other form of energy. In fact, as will be seen later, the presence of an electric current implies magnetism, or, as it is termed, a magnetic field around the conductor through which it is passing; while any change of the magnetism of any body or system,—or, as it is technically expressed, any change in the strength of the magnetic field,—immediately gives rise to electric currents.

Like electricity also, we know very little of its nature, though rather more than we do of the sister science. We know, for instance, that an iron bar when magnetized is longer than when not magnetized; and from various researches, principally by Professor David Hughes, we gather that the act of magnetization consists in an attempt by the molecules of the body to turn on their axis, and to place themselves in line with the direction of the magnetizing forces. All bodies conduct magnetism, some with greater facility than others; but of all bodies, iron and its compounds, steel and cast iron, alone exhibit appreciably the magnetic properties, which are:—

1. The property of pointing, when freely suspended, to those spots on the earth's surface known as its magnetic North and South Poles,—one end, or one pole, as it is termed, turning always towards the magnetic North Pole, and the opposite one to the magnetic South Pole.

2. The property of repelling the pole that,—if both were freely suspended beyond the influence of magnets other than the earth,—would point in the same direction, and of attracting the opposite pole. Thus, two north-seeking ends of a magnet; or, as they are called, two north poles repel each other, and two south poles repel each other; while a north and south pole attract each other.

3. The property possessed by a magnetized body of inducing magnetism in other bodies not in contact with it, and in such a manner as to cause motion between the two, if either is free to move, or if the inducing force is sufficiently powerful to overcome the mechanical resistance to motion.

As with electricity also, we have a magnetic circuit, which consists of a closed ring of attractions, and whose resistance to magnetization varies with the substance and with the dimensions of the magnetic conductor. Thus, a long, thin bar offers a greater resistance to magnetization than a short, thick one; and, stated shortly, the magnetic resistance offered by any body varies directly at its length in the direction of the magnetic circuit, and inversely at its cross section.

Steel offers a greater resistance to magnetization than pure wrought iron, as also does cast iron; and all three have the property of retaining their magnetism to a certain degree, when once they have been magnetized. As might be expected, upon the theory that the operation of magnetizing consists in a twisting of the molecules, those bodies, as steel and cast iron, which offer most resistance to the inducing force, as it is termed, retain more of their magnetism, and far longer than wrought iron. With very pure iron, such as Swedish, Farnley, or Lowmoor, it is very difficult to find any traces of magnetism when no inducing force is present, while either will give a very high return for a given magnetizing power that is applied. With steel or cast iron, on the contrary, it is by no means easy to induce them to accept of magnetization; but when once it has been accomplished, they retain a very large percentage for some considerable time.

These properties are of very great importance in the construction of electric and electro-magnetic apparatus. Thus, the needles of compasses and miners' dials are always made of steel, their property of pointing north and south being all the service that is required of them. In any apparatus where a selective action is required (or where an attractive power is required in a light, portable form, as in the magneto-telephone receiver), a piece of magnetized steel, or a steel magnet, as it is called, is used.

Where it is required to control the magnetic effect for producing motion, pure wrought iron is generally used, for the double reason, that a smaller weight will answer than with cast iron for the same work, and that it responds more readily to the magnetizing influence—usually an electric current—taking up and losing its magnetism readily at the will of the operator.

In dynamo electric machines,—where parts of the apparatus are required to retain their magnetism in the same sense, that is, with the same polarity, as it is termed, as long as the apparatus is working—those parts may be constructed from wrought iron or cast iron, according to the fancy of the designer; but he will have to provide a heavier weight of the latter, to do the same work.

Those parts containing iron which are in motion and continually changing the direction of their magnetization, as the iron core of the armature, are always made from the purest wrought iron obtainable.

It has been stated that there is a magnetic circuit of attractions, or a continuous path for the magnetism, just as there is a continuous path for an electric current; but with this difference, that magnetism always passes, no matter how great the resistance, and the effect of the magnetic resistance is simply one of degree.

Air, for instance, has an enormously greater resistance than iron, some 1400 times, according to a recent investigator, Mr. Kapp, to whom dynamo manufacturers are very much indebted for his able researches, and above all for his exposition of the law of magnetic resistance. Yet, if no other path be open, the magnetic influence will pass through air, imperceptibly, of course, until some body, such as a piece of iron, able to denote its presence, is placed within its influence.

Perhaps the method adopted for explaining the working of the electric circuit may be of service here. Imagine a ring of iron or steel, not covered. Iron or steel, because, as has already been explained, these substances conduct magnetism better than any others, so far as we know at present; uncovered, because we know of no substance that will act as an insulator for magnetism in the same sense that india-rubber or gutta-percha does for an electric current. The bodies which offer the highest resistance do conduct magnetism, even under moderate exciting power, to a very appreciable degree.

If we apply to any part of our ring an exciting power, such as an electric current passing in a wire wrapped round the iron, moderate in proportion to its resistance—that is, which will develop a moderate degree of magnetization in opposition to the resistance of the ring—we shall find scarcely any traces of magnetism anywhere outside the ring, though we can show, by suitable apparatus, as will be seen when we come to deal with transformers, that the magnetism is there, and is a perfectly measurable quantity. It has only passed by way of the ring, just as the electric current passes by way of a wire, because, with the force available, that is for practical purposes the only path open to it. Now let us cut out say one-sixteenth of the ring; and we shall find that we have created a totally different set of conditions, giving rise to totally different phenomena.

First, then, the piece we have cut out—if free to move, and placed at such a distance that the magnetic power is sufficient to overcome the friction, mechanical inertia, etc., present—will move back exactly into its old place, or as nearly as it can, when the exciting power is applied.

We shall find also that, if our ring is made of steel, it has retained a certain power of attracting the piece that we have cut out, after the exciting power has been removed. If our ring is made of wrought iron, it will pull the piece up sharply when the exciting power is applied; while, when the current is broken, it can easily be removed, and may even fall off itself if it is heavy in proportion to the attracting power. If we pursue the matter a little further, we shall discover another and very important phenomenon. It has just been remarked that, in the case of wrought iron, the piece of the ring we had cut out might detach itself under certain conditions. Let us find the conditions under which it will not detach itself. Let the piece we have cut out of the iron ring be replaced by a piece fitting very exactly, the four surfaces being planed true to each other. Now, we shall find that we have a slightly increased holding power when the ring is excited; and further, that after the exciting power has been removed, it will still require the expenditure of a certain amount of energy to pull it away. The reason is, that while the magnetic circuit is complete, a certain amount of magnetism remains in the iron even after the exciting power has been removed. Forcibly pulling away the armature, or keeper—as the piece of iron employed to close the magnetic circuit is usually called—dissipates this residual magnetism; and so, if we replace the keeper ever so truly and carefully in

* Walker's "Electricity."

its place, we shall not require the same effort to remove it as before. This phenomenon would form a very serious drawback to the working of many forms of electro-magnetic apparatus if there were no means of getting over it. Fortunately there are. It is sufficient if we break the iron magnetic circuit by a film of air, a layer of paper, or, more conveniently, a thin plate of brass, to get rid of what would otherwise be the troublesome effects of residual magnetism.

We shall also find another phenomenon arise from our having broken our ring by taking out a sixteenth part as described. It has been explained that the magnetic influence always passes, no matter what may be the medium ; the effect of the insertion of a resisting medium being merely the reduction of the strength of the magnetism ; and it was also explained that though magnetism passed invisibly, it could be rendered evident by the presence of iron. This may be shown in a very striking manner. If we take our ring minus its sixteenth, place a sheet of paper or glass over it, and sprinkle iron filings over the aperture, we shall find these filings, when free to move under the influence of the exciting power, arranging themselves in regular order from one end of our ring to the other, across the break ; and if we investigate the matter further, we shall find that the reason these iron filings arrange themselves in this way is because each has become a small magnet under the influence of the exciting power of our ring, and each places itself in accordance with the two laws before stated, viz. :—

1. That, it being a magnet, having a N. pole, that should point to the S. pole of the large magnet, and the S. pole of the filing to the N. pole of the large magnet.

2. That the N. poles of the filings repel the N. poles of other filings, and the S. poles the S. poles ; and the joint operation of these two laws produces the curves shown, which Faraday termed the lines of force, or the direction in which the magnetic force is manifested.

As a ring would not usually be a convenient form for a magnet that is to be used in electro-magnetic apparatus, the horse-shoe form is generally adopted. For permanent steel mrgnets, a strip of steel is bent into the form shown in Fig. 1, and its magnetic circuit is closed by another strip of steel or iron, or by some portion of the apparatus of which it is to form a part. For electro-magnets, the horse-shoe form is also generally adopted, but it is made in four pieces instead of two, viz., two limbs upon which the wire that is to carry the exciting current is wound ; a yoke, or back piece to complete the magnetic circuit on that side ; and the armature, facing the poles, and moving in accordance with the will of the operator who controls the electric current, to complete the magnetic circuit on the other side, as Fig. 2.



Fig. 2.—Horse-shoe Steel Magnet.

Lines of Force.—Before going further, it will be as well to deal with Faraday's very beautiful, but somewhat puzzling, conception, the lines of force.

Lines of force bear the same relation to magnetism that

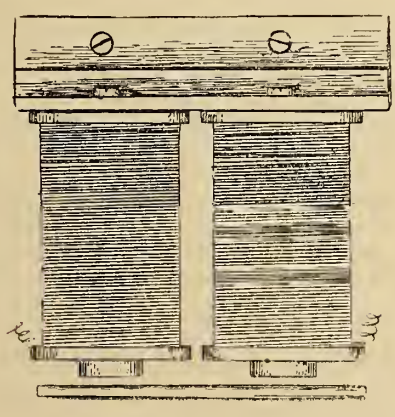


Fig. 2.—Four-Piece Electro-Magnet With Armature.

current does to electricity. The production of lines of force is the result of the work done by a given magnetic exciting power, in opposition to the magnetic resistance opposed to it ; just as an electric current is the result of a given E.M.F. acting in opposition to a given electrical resistance. Moreover, the number of lines of force passing at any point is a measure of the strength of the magnetism at that point, just as the number of amperes passing in any electric circuit, or part of a circuit, is the measure of the strength of the electric current passing. As in an electric circuit also, the current strength is the same in every part of the circuit, so too in the magnetic circuit, the number of lines of force passing is the same in every part ; with the proviso, as with the electric circuit, that if two or more paths are open to the lines of force, they will divide between those paths or branch circuits in the inverse ratio of the resistance of the several paths. Thus, if there be two paths open to the lines of force, one through the air and the other through iron, the dimensions being the same, they will divide in the ratio, according to Mr. Kapp's figures, of 1440 : 1. One part passing through the air and 1440 through the iron. It can easily be seen, however, that if the air path should be short and of large cross sections, while the iron path was the reverse, an appreciable portion of the lines would pass through the air. This point comes out very strongly in the matter of designing dynamo machines ; what is known as the leakage path being in some cases of comparatively low resistance, owing to the form of the machine.

As with amperes also, lines of force are definite measurable quantities. Dynamo manufacturers calculate how many lines of force they have passing into an armature, and what the section of the iron should be to accommodate them, just as they calculate the number of amperes required in a given case, and the section of conductor required to accommodate them. But we have no convenient quantities as yet, like the volt and the ohm and the ampere, that we can refer to as analogous to the foot-pound in mechanics. We have no familiar name representing so many lines, though probably it may not be long before we have one. In order to render the subject clear, therefore, we can only refer back to the foundations of all these units, those of force, mass, and time. The unit line is that force which will move the unit body, the gramme, over unit distance, the centimetre, in unit time, the second. Therefore, when we say that there are so many lines of force passing into the armature of a given dynamo, we mean that we have the power present within the armature to do that number of centimetre-grammes of work in unit time, under the influence of the magnetism created in the machine ; and, as engineers well know, these quantities are directly convertible into the more familiar foot-pounds, and H.P.

Lines of force, then, show the direction in which the magnetism present will cause any free magnetizable body to move; and the number of them at any point, referred to unit quantities as detailed above, show the force of magnetism available there, or, as it is termed, the strength of the magnetic field.

It must not be imagined that magnetism and lines of force represent continuous motion of the molecules of the body through which the magnetism passes ; or that we should be justified in calling what we now know as lines of force, a magnetic current. They are nothing of the kind, nor are they analogous to an electric current, except in so far as has been described, and for two reasons. First, because magnetism is an influencing or inducing force, like gravity, and not a moving force like heat or electricity ; and secondly, we *have* a magnetic current, viz., the motion that takes place in the magnetic circuit, among the molecules of the bodies through which the magnetic influence passes, at the moment the exciting power is applied, and at the moment when it ceases.

It will be easily understood from what has passed, that as the lines of force passing through air, say from pole to pole of a magnet, can radiate in all directions, unless their path is shaped for them by the introduction of some piece of iron, such as the armature, the force exerted varies, as in all similar cases, inversely as the square of the distance from the poles. It is doubtful, however, if this law holds good in a sufficient number of cases to be of any value, as it is evident that it must be subject to modification by every change in the conditions present.



Fig. 3.

It has been mentioned that the existence of an electric current passing through a conductor, implies a magnetic field around

the conductor. Thus, if a current be passing in a wire, lines of force are created in concentric circles around it (Fig. 3). That is to say, a small magnet such as a magnetized steel filing, if free to move, would place itself tangential to a circle of which the wire formed the centre, and simple iron filings take up positions in concentric circles round the wire, just as they do in curves across the poles of a magnet. As before, the lines of force show not only the direction of the magnetic influence, but their number

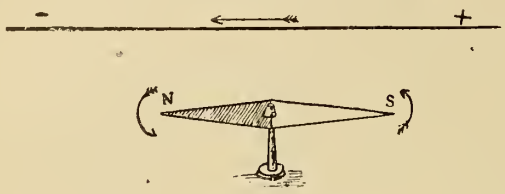


Fig. 4.

or density shows the strength of the field surrounding the wire; and this again is proportional to the strength of the current passing, and inversely to the distance from the conductor.

The first effect of this property of electric currents that became of any practical value, was the power which it gave of deflecting a magnetic needle out of the positions we have seen it assumes, pointing parallel with the line of the earth's N. and S. poles. Thus, if a magnetized compass needle be suspended under a wire, it will be found that when a current passes in the wire, the needle will be deflected, the N. pole going to the *left* when the

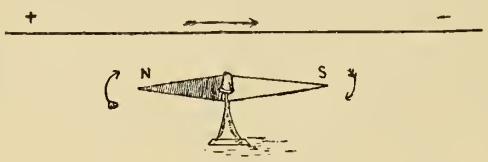


Fig. 5.

current passes from S. to N. (Fig. 4) *over* it, to the *right* when the current passes from N. to S. (Fig. 5) *over* it, to the *left* when the current passes from N. to S. *under* it (Fig. 6), to the *right* when the current passes from S. to N. *under* it (Fig. 7). Thus, a current passing from N. to S. *over* the needle and coming back from S. to N. (Fig. 8) *under* it, will deflect the needle in the same direction, the N. pole turning to the right; while a current passing from N. to S. under, and coming back from S.

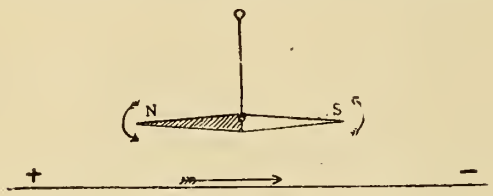


Fig. 6.

to N. over, deflects the N. pole to the left; and on this principle a large number of electrical measuring instruments are made; an insulated wire being passed continuously round the needle in the same direction. It will be obvious that such an apparatus enables us to discover the direction of any current passing through the wire coils; and further, that, as the influence of the current upon any given needle will vary with the number of

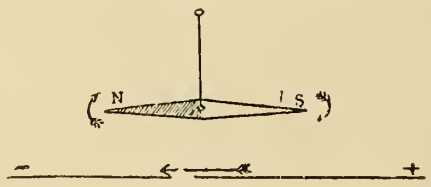


Fig. 7.

turns, and with the current passing through the coils, we have to our hand the means of measuring the strength of the currents we are using. This will be dealt with fully when measuring instruments are under consideration.

Electro-Magnetism.—The law which has been enunciated which rules the deflection of a magnetic needle when suspended under or over a wire, or inside a wire coil, holds good equally if, in place of a movable magnetic needle, we have a bar of iron or steel, surrounded by a coil of wire in which a current is passing. If the current passes over the bar from us, and returns under towards us, as shown in Fig. 10, the N. pole is on the left and the S. pole on the right.

From this it will be seen that we are able to magnetize a bar in either direction, with any given wrapping of wire, by simply reversing the direction of the current passing in the wire.

It will be understood also, that the number of lines of force, or the amount of magnetization developed in any bar, will vary in accordance with the law we have stated, viz.:—it will depend directly on the exciting power, and inversely on the magnetic resistance opposed to it.

The exciting power, again, varies directly as the strength of the current passing in the wire, and as the number of times it

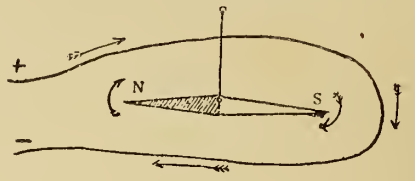


Fig. 8.

passes round the bar, or, shortly, as the ampere turns. And it will follow immediately from these two, that with a short thick magnet we require less exciting power, fewer ampere-turns, than with a long thin one; since, other thing being the same, the magnetic resistance of the former is less than that of the latter. The resistance of each leg, taking the horse-shoe form, is less; and also the resistance of the back, or yoke, of the

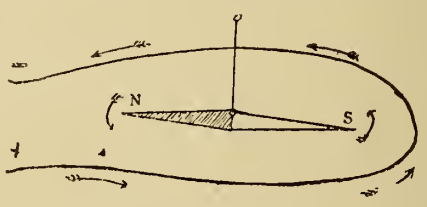


Fig. 9.

armature and of the air space between the poles and the latter, because the cross section will be necessarily larger.

This is in direct contradiction to the ideas that prevailed in the early days of electricity, and to those which are to be found in some of the older text-books. In those days it was thought that you gained power by increased length. The error was probably due to the actual fact that you may gain power by using a long electro-magnet, but from a totally different cause, viz., the increase of the exciting power. Electro-magnets are often constructed by taking a piece of iron and wrapping on it as much wire as you can. As each succeeding layer of wire is

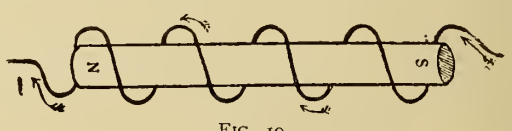


Fig. 10.

farther and farther from the iron, its exciting power becomes less in proportion, whilst its electrical resistance becomes greater in proportion to its length, so that you soon reach a point at which there is no advantage gained by adding more wire. If you take a longer bar, you increase your magnetic resistance, but not so much as to balance the increased exciting power that you gain from the additional wrapping space.

Steel is never used for electro-magnets, except in special cases, and cast iron only in the case of the field magnets of dynamo, where the direction of magnetization does not change. For all other purposes, wrought iron of the very purest quality obtainable is used; the dimensions are either calculated or determined by experiment, or calculated from *data* furnished by experiment; and the exciting power is an electric current passing in a cotton or silk-covered wire, wrapped round and round each limb of the magnet.

Messrs. Hy. S. Thornberry & Co., proprietors of the Toronto Electrical Works, have recently removed to new and more commodious premises at 35 Adelaide street west, and address themselves to the users of electrical materials through the columns of the present number of the ELECTRICAL NEWS.

ONTARIO ASSOCIATION OF STATIONARY ENGINEERS' ACT.

FOR the information of those of our readers who may have been unable to obtain a copy of the Act recently passed by the Ontario Legislature incorporating the Ontario Association of Stationary Engineers, it has been deemed advisable to print the measure in full. It reads as follows :—

WHEREAS it is deemed expedient to incorporate the persons hereinafter named, and all persons who shall hereafter cause their names to be registered, as an association for the purpose of holding examinations and granting certificates of qualification and efficiency as stationary engineers:

Therefore Her Majesty, by and with the advice and consent of the Legislative Assembly of the Province of Ontario, enacts as follows :—

1. Prof. J. Galbraith, John Galt, M.E., A. E. Edkins, William Sutton, A. M. Wickens, J. A. Wills, all of Toronto; Hugh Fairgrieve, Robert Dickinson, Robert Mackie, Sylvester Potter, all of Hamilton; Arthur Ames, of Brantford; James Devlin, of Kingston; and all persons who shall cause their names to be registered under the provisions of this Act, shall be, and are hereby incorporated under the name and style of "The Ontario Association of Stationary Engineers," hereinafter referred to as "The Association."

2. The Ontario Association of Stationary Engineers shall be a body corporate by the name aforesaid, having a perpetual succession and a common seal, with power to acquire, hold and dispose of personal and real estate, for the purposes of this Act, and to sue and be sued, in the manner usual with such corporations.

3. Every person registered under the provisions of this Act shall be a member of the said Association.

4. There shall be a Board of Management of the said Association, to be appointed in the manner provided for in this Act and hereinafter referred to as "The Board."

5. The said Prof. Galbraith, John Galt, M.E., A. E. Edkins, William Sutton, A. M. Wickens, J. A. Wills, Hugh Fairgrieve, Robert Dickinson, Robert Mackie, Sylvester Potter, Arthur Ames and James Devlin shall be the officers and Board of the said Association until others, under the provisions of this Act, shall be elected to fill their place.

(2). The members of the said Board shall meet in the city of Toronto, in the county of York, for the purpose of organization, within one month after the passing of this Act.

Any five members of the Board shall form a quorum.

(4). The members of the Board shall hold office for the term of three years, and there shall be an election each year of three members, the first Board hereby appointed determining by lot the order of their retirement at the expiration of one, two and three years respectively, and any retiring member shall be eligible for re-election.

6. All subsequent members of the Board shall be elected by ballot, in such manner as may be provided for by the by-laws of the Association, at the annual meeting of said association, or at a special meeting called for that purpose, and the member or members obtaining the greatest number of votes sball be declared elected.

7. No person shall be eligible for election to the Board, or qualified to fill any vacancy thereon, or to vote for any member thereof unless duly qualified under the provisions of this Act and the by-laws of the Association.

8.—(1) In case of the resignation or death of any member or members of the board not exceeding four, the other members of the board shall have power to fill all vancancies so caused, until the time of the holding of the next annual meeting; provided said annual meeting is not to be held within a period of three months of the occurring of such vacancy or vacancies.

(2) In case of the resignation or death of five or more members of the Board, the president or vice-president of the Association, or in case of their, or either of their default for a period of ten days, any five members in good standing shall have power to call a special meeting of the Association upon a notice of not less than ten days, for the purpose of filling the vacancies so caused.

(3) In case of an election to fill the vacancies referred to in sub-sections 1 and 2, the member receiving the greater number of votes shall be considered the member elected to fill the vacancy which shall require the longer time to expire, and so on until all the vacancies are filled.

9. In case of any doubt or dispute as to who has or have been elected a member or members of the Board, or as to the legality of the election of any member or members of the Board, it shall be lawful for the other duly elected members to be, and they are hereby constituted a committee to hold an enquiry and decide who, if any, is or are the legally elected member or members of the Board, and the person or persons, if any, whom they decide to have been elected, shall be and be deemed to be the member or members legally elected, and if the election is found to have been illegal, the said committee shall have power to order a new election.

10. Meetings of the Association and the Board shall be held at such times and places as may be fixed by the by-laws of the Association or Board respectively; and in the absence of any rule or regulation as to the summoning of meetings of the Association or of the Board, it shall be lawful for the president, or in the event of his absence or death, for the registrar, to summon the same at such time and place as to such officer seems fit, by circular letter to each member.

11. In the event of the absence of the president from any meeting, the vice-president, or in his absence, some other member to be chosen from among the members present shall act as president.

12. All questions submitted to the Association, or the Board, shall be decided by a majority of the members present, not being less than five in number in case of the Board, and twenty in case of the Association.

13. At all meetings, the president for the time being shall have only a casting vote.

14. There shall be paid to the members of the Board such fees for attendance, and such reasonable travelling expenses as may be fixed by by-laws passed by the Association at the annual meeting.

15. The Board shall annually elect from among its members a president and vice-president, and shall appoint a registrar, treasurer, solicitor, and such other officers as may be necessary for the working of this Act, who shall hold office during the pleasure of the Board, and who shall, as well as being officers of the Board, hold the like position as officers of the association.

16. The Board shall have power to fix by hy law the salaries or fees to be paid to such officers, and to the board of Examiners hereinafter appointed.

17. The said Board may make rules and regulations for their own conduct and for the uniform inspection of steam plant, for the conduct of examinations, for fixing all fees to he charged and for such other purposes as are necessary under this Act, but nothing herein contained shall he deemed to give the Association any powers of compulsory inspection.

18. The Board or a Committee thereof shall examine all persons applying under this Act, and shall have power to issue certificates, and such certificates shall in plain terms name the particular steam plant the holder is qualified to operate.

19.—(1) All persons shall on application for examination, pay such fee for such examination, including certificate as may be prescribed.

(2) No certificate or renewal thereof shall be granted to any person addicted to the excessive use of intoxicating liquors, and such certificate may at any time be revoked when the holder thereof has been shown to have been guilty of gross carelessness, incompetence or intemperance.

10. The expression "steam plant," wherever the same occurs in this Act, shall include boilers and steam engines and every part thereof or thing connected therewith, and all other apparatus and things attached to or connected therewith or used with reference to any such engines or under the care of the engineer.

THE FELINE MOTOR.

THE INVENTION OF A WESTERN GENIUS AND ITS MODE OF OPERATION.

STOUGHTON, Dane County, Wis., May. 19.—Prof. Richard de Long, the inventor of the new feline motor, is a tall, pale-faced man, with a three-storey. bay window forehead, overhanging a pair of deep set, sky blue eyes, set on each side of a large, thin hooked nose. He is not a beauty, but he is a genius.

His feline motor, which at present is creating such a sensation in scientific circles in Stoughton, is a marvellous machine, unique in appearance, and wonderful in operation. It may be described as a curious combination of large and small fly-wheels, great balance-wheels, bright steel rods, and an almost innumerable number of coils of copper wire, all joined to a brightly-polished cylinder of brass, one end of which projects into a wire cage filled with ordinary cats. Its operation is very simple, but surprising in its results. A slight pull on a small nickel-plated lever starts the machine. Then like lightning from out the end of the cylinder projecting into the cage there shoots a long steel arm and hand, grabbing one of the cats by the nape of the neck and yanking it into the cylinder, where it disappears with a yowl of more than feline terror. In a moment the fly-wheels, the great balance-wheels, and all of the complicated machinery begins to move, at first slowly, but soon with startling rapidity. At the proper moment, which is indicated by a small clock-like attachment, the operator pulls another lever, when from out of the other end of the cylinder, with hair and tail erect, scintillating eyes, and a caterwaul dislocating to one's spinal column, the cat is projected into a tub of cold water prepared for its reception.

This operation, surprising as it may seem, extracts from the cat electricity equivalent to the power represented hy ten horses, working for one hour, and this power can be stored in the cylinder until needed. As a cat can be run through the motor every three minutes, and all the accumulating electricity be stored, the power of the machine is practically limitless. The same cat can be used once in every ten hours without in the least impairing its health and general usefulness.

The professor is jubilant over the success of his invention. He is satisfied that he has overcome every difficulty, and intends soon to put the machines upon the market. In speaking of the origin of the invention and the probable results of its use, he says :

"I have long believed that the cat is nature's Leyden jar, charged with an enormous amount of electricity, but in such a manner as to require a peculiar process to extract it. This process it has been my good fortune to discover. The discovery will be of incalculable benefit to mankind. It will revolutionize the mechanical world, and be felt in every department of life. By its means every family, no matter how poor, can have its home brilliantly lighted with electricity at a less cost than to have it poorly lighted with kerosene. By simply running the now practically useless house cat through the machine twice each day a sufficient amount of electricity can be engendered to illuminate brilliantly any medium-sized house. Think how advantageous it would be to a large city. Take New York, for example. Carefully compiled statistics show that there are at present within the city limits 9,997,347 cats. This represents very nearly a 20,000,000 continuous horse power, or enough to light the entire city and furnish all the motive power needed to do its work. The feline motor will do away with steam. Ten years from now, I venture to say, there will not be a steam engine in active operation in the United States."

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ADVERTISEMENTS.

Advertising rates sent promptly on application. Orders for advertising should reach the office of publication not later than the 25th day of the month immediately preceding date of issue. Changes in advertisements will be made whenever desired, without cost to the advertiser, but to insure proper compliance with the instructions of the advertiser, requests for change should reach the office as early as the 22nd day of the month.

SUBSCRIPTIONS.

The ELECTRICAL NEWS will be mailed to subscribers in the Dominion, or the United States, post free. for $1.00 per annum, 50 cents for six months. The price of subscription may be remitted by currency, in registered letter, or by postal order payable to C. H. Mortimer. Please do not send cheques on local banks unless 25 cents is added for cost of discount. Money sent in unregistered letters must be at senders' risk. Subscriptions from foreign countries embraced in the General Postal Union, $1.50 per annum. Subscriptions are payable in advance. The paper will be discontinued at expiration of term paid for if so stipulated by the subscriber, but where no such understanding exists, will be continued until instructions to discontinue are received and all arrearages paid.

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The Publisher should be notified of the failure of subscribers to receive their papers promptly and regularly.

EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

OUR SPECIAL CONVENTION NUMBER.

THE National Electric Light Association of the United States has conferred honor upon Canada by selecting the city of Montreal as the location of its next semi-annual convention.

The ELECTRICAL NEWS proposes to mark appreciation of the event by publishing early in August a special Convention Number, which is designed to be attractive in form and interesting in contents.

This Convention Number will set forth the progress which electricity is making in Canada by descriptions and illustrations of a number of the most prominent enterprises established here within the last decade. Other features of equal interest will assist in making it one of the most attractively interesting publications ever issued in Canada.

A large number of copies will be printed and placed in the hands of owners and managers of electrical industries throughout Canada and the United States. A liberal distribution of copies will also be made at the Convention.

Several Canadian and American manufacturing companies have already engaged advertising space in this Convention Number, and many others will doubtless see the advantage of being represented in its pages. The terms have been made as reasonable as possible, and we have no hesitation in saying that those who have announcements to make to the users of electrical and steam apparatus can by no other means reach so effectively and economically the desired constituency.

SOME of the leading spirits in the Canadian Association of Stationary Engineers are of the opinion that the reading of two or three papers on pertinent subjects would form an interesting and instructive feature of the annual meeting in September, and negotiations are in progress with a view to carrying the idea into effect. The step is in the right direction and should be heartily received by the membership.

As there will be a considerable number of delegates to the forthcoming convention of electric light men in Montreal who will pass through Toronto either going or returning, or both, it would be a graceful act on the part of Toronto electricians to make some provision for their entertainment and convenience in the city. We suggest a meeting of local electricians to devise ways and means to keep up the reputation of the Queen City for hospitality and goodfellowship. A headquarters should be established as a rendezvous for the electrical pilgrims while in the city, with representatives of the electrical fraternity on hand to do the honors in the most agreeable manner and make their stay amongst us a feature of the convention. Let us hear from our Toronto representatives without delay.

"A little laughter now and then
Is relished by the wisest men."

FOR this reason we do not apologize for printing in another column a telegraphic report from Dane County, Wis., to a Toronto daily paper, under the caption of "The Feline Motor." The electrician, notwithstanding his daily struggle with the equation $C \frac{E}{R}$ and its concomitants, is as capable of enjoying a good joke as well as any man that breathes. Having also a keen appreciation of what is becoming known as the "electric fake," he will be abundantly repaid by perusal of this piece of richly humorous satire. Colonel Sellers died too soon, for this so-called "electrical age" would have offered brilliant opportunities for his peculiar genius. The enthusiastic way in which the Dane County professor figures up the millions of horse-power available, and his anxious solicitude that the poor man's family should have all the luxuries of electric lighting, reminds us of a half-forgotten face we used to know in former days, but in the closing paragraph we recognize and welcome an old, familiar friend—"Ten years from now, I venture to say there will not be a steam engine in operation in the United States." The most suggestive and absurdly funny climax to the whole business, however, is that the man who called our attention to the report in question believed it to be the relation of a solemn and actual fact.

IN these days when everything that savors of monopoly is unsparingly denounced, it is refreshing to run across a business which can best serve the public while it remains a monopoly, and in which competition has the effect of raising prices instead of reducing them. This unique position is held by the telephone exchange. It is a business that can best be described as a natural monopoly. When that feature is destroyed, its usefulness is gone. A competing exchange, if established, would only succeed in dividing the business so that public offices or business men would require the instruments of both concerns in order to reach their clients. The outcome of the fight now going on in Toronto where an opposition to the existing order of things has been inaugurated, is being watched with the deepest interest by not only the citizens here, but by the other cities in the province. Owing to real or fancied grievances the opposition at first developed considerable strength, but as soon as it was realized that competition did not compete, the feeling grew that if the existing company met the citizens' views in a fairly reasonable manner, it would be better to leave them in undisturbed possession of the field. Two companies, each receiving half the present rates, could not long exist. The result would inevitably be amalgamation in the future, with increased rates and the streets disfigured with a double lot of lines and poles, so that the last state of the citizens would be incomparably worse than the first.

WATER power has heretofore been considered a very desirable factor in electric lighting operations, and where it can be obtained within reasonable distance it has considerable value. There are few water powers, however, that have sufficient capacity for electric purposes on a large scale, and when they do exist, are already in use and have a value that leaves but a small margin of advantage over steam. A number of small plants throughout the country that have been established on small water privileges of over estimated capacity have had to resort to steam. The troubles incidental to ice in winter and drought in summer, have in a many cases reconciled the proprietors to the change. The rival of the water privilege is, however, looming up with considerable prominence. We refer to natural gas. The immense gas wells near Welland, from which the product is now being piped to Buffalo, are a case in point. It is evident from indications that cannot be mistaken by the practiced eye that these veins of natural gas underlie a great portion of the province. We believe that in or near Toronto gas may be obtained in large quantities, and we base the belief on the fact

of gas having been actually obtained in small quantities in several localities. The deepest bore probably is the one on the asylum property at Mimico, which was put down for the purpose of obtaining water. Gas is produced by this well, and if the drilling had been done with a view of obtaining gas, it would probably have been reached in large quantity. A gas well must be a dry hole—that is, must have the water cased off as it goes down. The water has a tendency to drown out and shut off whatever gas may be present. As water was the prime object of this well, it was, of course, not cased off—consequently the usual result, not much gas. With a liberal supply of natural gas near his plant, the electric light man will have no occasion to sigh for Niagara or any other falls to enable him to compete with any and every system of illumination that has yet been devised.

It is a pleasure to know that several meetings have already taken place in Montreal for the purpose of making proper arrangements for the reception of the members of the National Electric Light Association on the occasion of the approaching convention. Prof. Bovey, of McGill College, is at the head of the undertaking, and many prominent citizens are lending their assistance. There is, therefore, no reason to fear that the credit of the city of Montreal for hospitality will be fully sustained, and the pleasure of the visitors during their brief sojourn among us assured. His Excellency, the Governor-General, has communicated to Prof. Bovey the assurance of his deep interest in the convention, his pleasure that it is to take place in Montreal, and his purpose if possible to be present. The following gentlemen have been appointed as the Exhibition Committee: James I. Gulick, Chairman National Electric Light Association, 136 Liberty St., New York; M. D. Barr, W. A. Johnston, Frederic Nicholls, W. J. Morrison and J. Wright, Toronto; John Carroll, Prof. John Cox, A. J. Corriveau, Frank Redpath, S. C. Stevenson, Montreal; Gen. C. H. Barney, W. J. Hammer, New York; Henry Hines, Pittsfield, Mass.; F. Ahern, Ottawa, Ont.; A. A. Dion, Moncton, N. B. The advisability of postponing the date of the convention from August to September is being considered, and will be decided upon by the Executive Committee at a meeting to be held in Montreal a week hence. We incline to the belief that the weather in September would be found to be much more conductive to comfort and pleasure than in August.

It has been our opinion for some time that a successful and commercially practicable storage battery will only be obtained by a radical departure from the well-thumbed method that was the outcome of the experiments of Faure. Experience with accumulators of the lead type—in which one inventor's only differed from another in the various forms of leaden grid intended to hold the oxide or active material in position—has but confirmed us in this belief. The deterioration constantly going on in the cell by irreversible chemical action, and the mechanical result of this chemical action in disintegrating and distorting these plugs of active material, results in the speedy destruction or disability of the positive plates; and when in street car work the severe demands made on the battery, many times in the course of a trip, together with the disorganization caused by the shaking up they inevitably receive, are added to the inherent disabilities of this form of battery, it is no wonder that successful realization is not within reach. A more promising system is now under experiment in which the electrodes are respectively iron and copper, with an electrolyte of caustic potash, or more strictly speaking, potassium zincate. The idea is not new, but this is claimed to be a radical improvement on the alkaline accumulators brought out a year or two ago by Desmazure and his associates. The weight for a given power is about 55 or 60 lbs. per horse power hour as against 100 lbs. for the best form of lead storage batteries. The electromotive force of the couple is small, being about ·8 to ·9 of a volt, but the output is considered very great in proportion to the weight. The experimental trips of a car equipped with this battery appear to have been successful, and to give promise of commercial practicability, which is more than can be ordinarily said of storage battery cars; but of course with this, as with those that have gone before, time alone will tell what its success will be when operated under adverse conditions and by unskilled labor. Some electric appliances have a trick of working triumphantly when operated by an expert scientist, but collapse lamentably when subjected to the everyday test of wear and tear in the hands of the ordinary mortal.

It is somewhat singular that up to the present time the enormous energy developed by the falls at Niagara has been so little utilized. Even with the close proximity of the manufacturing and shipping port of Buffalo there appears to have been but a small measure of success in the various attempts that have been made. The hydraulic canal which was inaugurated with such a flourish of trumpets landed its projectors in bankruptcy, and after changing hands several times, is now but of small account. It is a strange comment on the enthusiasm which references to this mighty power almost universally evoke that the electric light station supplying Niagara Falls village with illumination, though well within sound of its deafening roar and almost watered with the spray of the cataract, is driven by a steam engine. There must be a good reason for all this. The principal one, we take it, is, that before factories can be established, there must be a market for the manufactured goods. The fact of power being present in unlimited quantity is no justification for the establishment of factories making goods that nobody wants, simply to use it up. Then again a water power, even under favorable circumstances, costs considerable to reclaim, and the interest on the outlay for real estate, flumes, waterways, turbines and so forth, has to be counted against the cost of steam, which, as a rule, is much less expensive to put in operation in the first place. Fuel is cheap in Buffalo, and the manufacturer has the advantage of his market around him, and is at the headquarters of railroad and navigation communication. It has been found much cheaper to produce the power for the entire electric lighting of the city on the spot than to take advantage of the hydraulic canal already built and practically unused at the falls of Niagara. Although quite feasible to carry arc lighting currents over the intervening space, the initial rent of the water power and interest on cost of the poles and wires would greatly exceed the cost of coal laid down on the spot at Buffalo. In 1878, Professor Thomson, then occupying the chair of chemistry in the High School at Philadelphia, demonstrated in the *Journal of the Franklin Institute* the entire feasibility of transmitting by means of electricity the power of Niagara to Buffalo and even New York, but with the level-headedness that has since placed him in the front rank of his profession, he saw at once that commercially it would not pay, so to-day it remains the possibility of the scientist rather than the speculation of a man of capital.

There are several schemes before the public at the present time having for their object the utilization of the power of Niagara, the prospectus of some of which combine in a curious manner the cupidity of the speculator and the benevolent intentions of the philanthropist. They want no profit on the land (?), but by figuring the horse power of the famous cataract at so much per horse power per year they are able to run up the profits to a tidy sum. There is a gentle flavor of Montague Tigg about the figures, likewise a suggestion of the Dane County professor, elsewhere referred to, in his elaboration of his scheme to utilize the latent electricity concealed about the 9,997,347 cats in New York city. Unfortunately the inexorable law of supply and demand here again stands in the way. The prospective inhabitants of the modern Utopia are expected to buy the land, and *pay* for their water power and undertake the expense of establishing their factories themselves. What chance they are likely to have when we find municipalties elsewhere, with the best of transportation facilities, offering *free* land, *free* water power (unlimited), and exemption from taxation as an inducement to the coveted factory to locate in their midst. But it is the electrical part of these schemes that we wish particularly to comment upon It is quite easy to talk about enormous power works by which enough electricity is to be generated to supply the towns of Hamilton, London, Toronto and so forth, with all their electric lights, street cars, and power for their manufactories. It is quite easy, we say, to *talk* about these things, but another thing to *do* them. It is true that elaborate experiments are now being tried in Europe to transmit power over long distances without so great a percentage of loss as to be commercially prohibitive, but from the extreme care that has to be taken at every step, and the fact that with the most perfect insulators suspended in oil

the experiment can only be conducted in dry weather, the chances for Toronto would seem to be somewhat remote. An alternating current of tremendous tension has to be employed, making the maintenance of the insulation an almost impossible task. As alternate current motors are as yet somewhat problemetical for distributing purposes, it would be necessary for the receiving transformer to work a large motor, which again would drive a dynamo of lower tension to distribute a direct current. We thus have (1) a low tension alternating current generated at Niagara; (2) then transformed to a current of intense electromotive force; (3) re-transformed to a lower e.m.f.; (4) utilized to drive an alternating motor; (5) which again would drive a direct current dynamo, (6) to distribute to consumers. Take into account loss at each of these changes, interest on cost of all this equipment, copper conductors 80 miles (as it is impracticable to cross the lake), cost of operating plant at generating and receiving end, repairs to all this high pressure business, and we think we are safe in saying that coal can be laid down in this city for equal power at one-fifth the cost. We think the youngest engineer that now manipulates a throttle in this the Queen City of the West, will grow grey in the service if he waits until he is displaced by the advent of electricity, "Monumental" or otherwise, that is generated by the power of the cataract of Niagara.

MONTREAL NO. 1, C. A. S. E.

Editor ELECTRICAL NEWS.

DEAR SIR,—As things are running nicely to-day, I thought I would embrace the opportunity to send you a word from Montreal No. 1, C.A.S.E. We have at present about 50 members in good standing, and at nearly every meeting we have a candidate for initiation. The officers are all live, wide-awake men, and I am sure work hard for the interests of the Association, but somehow they do not receive proper support from the members. There has been from the start a lack of interest on the part of some of the members. There seems to be an improvement now, but not to the proper extent. We have very small meetings at times, and this has a discouraging effect, as very few men care to talk to empty seats.

I would say to those members who stay away, that the day is not far distant when they will be sorry that they did not take advantage of the discussions that are held in our hall every Thursday evening.

Some will say "I am a practical engineer, and don't want any theory or book learning." To these I would say, remember the Vice-President's charge, viz., "Practice and theory combined will make you succeed where ignorance and carelessness will surely fail." They must remember that it is not the trade that elevates the man, but it is rather the man that dignifies the pursuit or calling; and that muscular power, though very good in its place, is not the most essential requisite of an engineer, but that the cultivation of the mind is the first step towards eminence in any trade or profession.

Again, you will often hear the remark, "What is the use of a man wasting his time learning all these rules and formulas, when there are so few openings for a first-class man?" My answer is: Get the information to make you a first-class engineer, and you will find scores of openings—in fact you will be in demand. You will seldom find a good mechanic walking the streets looking for a job. They are in demand. As I have taken up more of your valuable space than I intended I will cut this short, hoping that it may set some of the boys thinking.

Yours truly,

JOHN JACOB MCGINTY.

THE FIRST IN CANADA.

We have recently gone into the manufacturing of copper and brass for electrical purposes," said Mr. Fairman, President of the Dominion Wire Manufacturing Company, Montreal, to an ELECTRICAL NEWS representative. "You see," he continued, "we discovered in the Blue Book for 1889 that over 250 tons of copper wire was annually imported from the States to this country, and we thought there was an opening for us in the drawing of copper wire. The prospects were that the business would be small to begin with but in a few years would grow considerably larger. In anticipation of this trade, we entered into communication with the largest copper mill in the States and made arrangements by which they agreed to roll down the pure lake copper bars into rods for us at a reasonable figure and also to assist in building a mill here. This was carried out We were obliged to add a large wing, 150 feet by 60 feet, to our works at Lachine, also to put down expensive furnaces and machinery, costing, when completed, over $35,000. This plant and machinery, we fear, possessed greater productive capacity than the requirements of the country demand, producing ten tons per day of pure electric copper wire, which means about 3,000 tons yearly, while the consumption of Canada to-day is not more than 400 tons annually. This being the case, we can only run our furnaces two days in a week, and then let them cool down. Were it possible to keep running all the time we should be able to turn out the wire as cheaply, or even cheaper, than it is made in the States. Experienced men from there, to whom we have submitted samples for inspection, give testimony that it is of superior quality. Our mill is the first ever established in the Dominion for the manufacturing of copper wire. This is, as I said, a new branch for us. But, in addition, we manufacture all kinds of steel and iron wire, also barbed wire for fencing, brass wire, hay-bale ties and brass and steel wood screws."

Mr. Fairman then gave the reporter some interesting information about his works at Lachine, in which it came out that the company employs about 350 men, and have a monthly pay roll of over $16,000. The coal bill is also a large item, as payment for over 5,000 tons of coal is sent to Nova Scotia every year.

ONTARIO ASSOCIATION STATIONARY ENGINEERS.

THE incorporators as named in the Ontario Engineers' Act met in Toronto on the 25th ult. pursuant to the requirements of the Act, for organization.

Officers were elected as follows: President, A. M. Wickens, Toronto; Vice-President, R. T. Dickinson, Hamilton; Registrar, John A. Wills, Toronto; Treasurer, Robert Mackie, Hamilton.

Members of the Board will retire in the following order: S. Potter and R. T. Dickinson, Hamilton, A. Ames, Brantford, John Galt, M. E., Toronto, 1st year; Jas. Devlin, Kingston, Hugh Fairgrieve, Hamilton, Wm. Sutton and Prof. J. Galbraith, Toronto, 2nd year; R. Mackie, Hamilton, Wickens, Edkins, Wills, Toronto, 3rd year.

On motion of Jas. Devlin, Kingston was selected for the next annual meeting, which will take place on May 25th, 1892.

A Committee to draft by-laws was appointed, consisting of the Toronto members of the Board; also a Committee on a form of certificate. These Committees are expected to work quickly and report forthwith. If possible it is intended to have every thing in shape to issue certificates by the 1st of July.

The meeting was very interesting and harmonious, and it is evident from the interest taken that a great number of engineers will avail themselves of the opportunity to take out certificates.

TORONTO BRANCH NO. 1 C.A.S.E.

AT last regular meeting of Toronto Branch No. 1 C.A.S.E., held in room D, Shaftesbury Hall, on Friday, May 22nd, President A. E. Edkins, presided. After routine business had been disposed of, Mr. A. M. Wickens commenced a series of short lectures on electricity and dynamo machinery. He commenced by giving a list of the terms most commonly used in the study and applications of electricity, explaining these terms and comparing them with the terms used in steam engineering, and which have the same meaning in steam engineering (to the engineer), as the volt, ampere, ohm, etc., have to the electrician in electric engineering. Mr. Wickens also went into magnetism, and explained how magnets and permanent magnets were constructed, as well as the construction of the dynamo and motor in all their parts, in such a plain and comprehensive manner, that every member of the Association present, who gave attention to his remarks, could not fail to learn something of the (supposed) mysteries of the electric dynamo and motor.

Before the Association adjourned, a hearty vote of thanks was tendered to Mr. Wickens for his interesting lecture, to which he made suitable reply.

On motion of the vice-president, a committee of five were appointed to purchase some of the best books on steam engineering and electricity, the same to be kept in the Association's room for reference in settling, when necessary, any question or argument on these subjects.

Any engineer in or around the city of Toronto who feels that he would like to become a member of the C.A.S.E. and help the cause—and *himself*—can get all necessary information by applying to the Secretary, W. G. Blackgrove, 27 Brant street, engineer with Jas. Morrison, Adelaide street west, or to A. E. Edkins, President, 22 Agnes street, engineer with T. Eaton & Co., Yonge street, or to W. Lewis, Vice-President, engineer with Toronto Silver Plate Co., King street west.

The various Associations of the C.A.S.E. intend meeting for a picnic at Oakville on Dominion Day, when they will be glad to have the company of all engineers, whether members or not, who will join them.

WIDTH OF SINGLE LEATHER BELTING.

By R. Grimshaw.

The following table, here published for the first time, gives the widths of 7/32 inch leather belting required to carry various horse powers at various speeds per minute; the belt being in good condition and wrapping half-way around cast iron pulleys, also in good condition. The tensions allowed for are such as to put no injurious strain on single leather lacings while permitting no slippage of the belt on the pulley.

The conditions and results are such as would be approved and desired by leather belting manufacturers for belts of their own make running in their own shops; in other words, where they wished, as consumers, to get the best life, drive, and money's worth out of the belts used.

WIDTHS OF SINGLE LEATHER BELT REQUIRED.

H. P.	Belt Speeds, Feet per Minute.								
	1,000	1,250	1,500	1,750	2,000	2,250	2,500	2,750	3,000
5	3.25	2.60	2.17	1.86	1.63	1.45	1.30	1.18	1.08
10	6.50	5.20	4.34	3.72	3.25	2.89	2.60	2.36	2.17
15	9.76	7.80	6.50	5.57	6.88	4.34	3.90	3.55	3.25
20	13.01	10.41	8.67	7.43	6.50	5.78	5.20	4.73	4.34
25	16.26	13.01	10.84	9.29	8.13	7.23	6.50	5.91	5.42
30	19.51	15.61	13.01	11.15	9.75	8.67	7.80	7.09	6.50
35	22.76	18.21	15.17	13.01	11.38	10.12	9.10	8.28	7.59
40	26.01	20.81	17.34	14.86	13.01	11.56	10.40	9.46	8.67
45	29.26	23.41	19.51	16.72	14.63	13.01	11.71	10.64	9.75
50	32.52	26.01	21.68	18.58	16.26	14.45	13.01	11.82	10.84
55	35.77	28.62	23.85	20.44	17.88	15.90	14.31	13.01	11.92
60	39.02	31.22	26.01	22.30	19.51	17.34	15.61	14.19	13.01
65	42.27	33.82	28.18	24.16	21.14	18.79	16.91	15.37	14.09
70	45.53	36.42	30.35	26.01	22.76	20.23	18.21	16.55	15.18
75	48.78	39.02	32.52	27.87	24.39	21.68	19.51	17.74	16.26
80	52.03	41.62	34.69	29.73	26.01	23.12	21.81	18.92	17.34
85	55.28	44.22	36.85	31.59	27.64	24.57	22.11	20.10	18.43
90	58.53	46.83	39.02	33.45	29.27	26.01	23.41	21.28	19.51
95	61.78	49.43	41.19	35.31	30.89	27.46	24.71	22.47	20.59
100	65.03	52.03	43.36	37.16	32.52	28.90	26.01	23.65	21.68

—N. Y. *Electrical Engineer.*

BOILER INCRUSTATION.

Some experiments made about twenty years ago, on the non-conducting properties of boiler scale, gave astonishing results. The effect of scale accumulation is given as follows: 1-16 in. thick requires 15 per cent. more fuel; ¼ in. 60 per cent. more fuel; and at ½ in. thick, 150 per cent. more. This we presume contains some guess work, but if varying from the truth, is not too great an estimate of loss by incrustation.. This, however, is by no means the main fact in the matter, at least where fuel is cheap. The destruction of boilers, and danger, are more important still.

To produce steam at 90 lbs. pressure in a clean boiler, only 325° of heat are required, but with heavy scale this temperature must be increased 200° to 300°. For ½ in. of scale the heat must be 700°, or almost a low red heat for the iron. The life of a boiler has no measure of time under these circumstances; so there is neither security nor economy in working encrusted boilers, and no one will do it who is acquainted with the facts above given.

We have had a good deal of experience in the use of solvents and precipitants, also without them, especially with water depositing scale of the carbonates of lime and magnesia, and believe there is scarcely any case where scale may not be prevented by the use of proper compounds chemically adapted to their purpose. As to picking and chaining off hard scale, we believe it to be impracticable. Men can not be trusted with such work, even if it could be done.—*Industry.*

RIBBED TUBES FOR BOILERS.

A series of experiments have just been concluded with a new kind of marine boiler tube, which promises to have considerable effect on the future of steam propulsion. The external surface of the tube shows no difference to the ordinary pattern, but internally it is ribbed longitudinally according to a plan patented by M. Serve. These ribs are spaced one-eighth of the internal circumference apart, and are about one-sixth the internal diameter apart.

The experiments were conducted with two boilers of the same size and pattern in all respects, excepting in the matter of tubes. The boilers are ten feet six inches in length, and the same in diameter. The grate surface in each is 31 square feet. The total heating surface of the boiler fitted with the Serve tubes is 1,536 square feet, and of the other 956 square feet. The tubes are of the same diameter in each boiler, and each has 126. A twelve hours' trial was carried out on October 22, each boiler under the same conditions burning 11,872 pounds of coal, but whereas the Serve boiler evaporated 114,600 pounds of water, the other only evaporated 103,000 pounds; or, the Serve boiler made 9.65 pounds of steam for every pound of coal burned, and the other 8.67. That is to say, the Serve boiler evaporated one pound of water more than the other did for each one pound of coal. If this advantage should prove to be the same in the actual practice of using the steam, the efficiency of the ordinary marine tube boiler will have been increased more than ten per cent., and this, added to the advantages gained by the use of steam at high pressure, will bring down the coal consumption per I. H. P. per hour almost to the vanishing point. London *Field.*

WHERE TO CUT-OFF.

A correspondent of *Power and Transmission* asks: "I want to get 55 pounds mean effective pressure on my engine. and wish to know where to cut off if I have 60 pounds on the boiler, and where if I have 75 pounds. I am told that the clearance is 5 per cent." Our contemporary's answer is as follows: In the case with only 60 pounds on the boiler, you would probably have only about 55 or so in the cylinder to start with, and could not cut off at all; you would need full steam. In fact, you might start with 55 pounds initial pressure and by reason of condensation, wire drawing, etc., have less than 55 pounds M. E. P., even with full steam all the way out.

To get 55 pounds mean effective pressure, requires 55 + 14.7 = 69.7 pounds average total pressure. This with 74.7 pounds initial, calls for 69.7 ÷ 69.7 = 0.933 as much average total as total initial pressure. Allowing 5 per cent. clearance we shall try various actual expansion rates until we catch one which figures up right; for this problem in engineering must always of necessity, where there is clearance, remain one of "cut and try."

We shall try 1.1 actual expansion rate. Its hyperbolic logarithm is 0.0953 and as with clearance 5 per cent. it would call for cut off at 0.9045 stroke, it would give an average total pressure of 0.9955 times the initial total. This would be too much.

Trying 1.3 actual expansion rate, which has 0.2624 as its hyperbolic logarithm, it calls for cut off at (1.05 ÷ 1.3)—05 = 0.7577 stroke, and gives an average total pressure which is .8077 × 1.2624 = 9696 the initial total. Still too much.

Trying 1.6 (hyp. log. 0.47) this calls for cut off at .6063 stroke and gives average total 0.9148—not enough; so we must search between 1.6 and 1.3.

Trying 1.5, which was hyperbolic logarithm of 0.4055, and calls for cut off at 8.65 stroke, we find that it yields 0.9339 as much average total as initial total. This is practically what is wanted; so very trifling less amount too late that it is not worth considering.

For 75 pounds boiler pressure by the gauge (69.7 pounds absolute) the same class of calculations can be carried on.

RECENT CANADIAN PATENTS.

No. 36261. J. E. Waterous, Journal box.
No. 36264. F. Field, Steam boiler.
No. 36270. C. Carlyle, Steam engine.
No. 36280. M. Johnson, Steam pump.
No. 36350. E. McCluer, Metallic circuit system.
No. 36355. D. Dorrance, Grate bar.
No. 36363. C. Ouston, Fuel saving compound.
No. 36380. F. L. Decarie, Stop valve.
No. 36381. J. Wood, Dynamo.
No. 36382. " Arc lamp.
No. 36383. " Journal bearing.
No. 36387. P. Hathaway, Galvanic battery.
No. 36398. D. C. Adams, Smoke consumer.
No. 36401. W. H. Dodge, Pulley.
No. 36402. J. A. Woodman, Electric wire protector.
No. 36435. R. James, Cut off valve.
No. 36448. H. Coodson, Valve.
No. 36453. E. Tregurtha, Steam boiler.
No. 36470. J. Van de Poele, Electric railway.
No. 36473. W. Morrison, Boiler.
No. 36481. H. Peterson, Furnace.
No, 36482. W. Hodgdon, Telephone.
No. 36490. A. Barrett, Electric conductor.

COMPOUND COMBUSTION.

At this day, probably, more than at any other, has the subject of fuel and combustion received the greatest consideration. From a sanitary point of view the question of smoke abatement is a serious one and one that is receiving attention not heretofore given it. The question of economy is a considerable item in the consumption of fuel, as the greatest amount of serviceable heat from the least amount of fuel is an end desirable to attain. The *Irish Textile Journal* contains an article on this subject which is of present and practical interest, and it deals with the subject from the correct view :

In connection with commercial and industrial enterprise, the efficient and economic generation of steam probably affords a wider field than any other for the profitable application of technical skill and inventive ingenuity. The best practice in modern boilers shows that little more than one-half of the available heat contained in the fuel is transmitted to the water for its conversion into steam, while it is notorious that the bulk of this surplus heat is wasted in the chimney. Nor is the enormous pecuniary loss resulting from this wasteful misuse of coal less objectionable than the injury and inconvenience arising from the escape of the unutilized constituents of the fuel ; for it is indeed only in rare and isolated instances that the generation of steam is effected at all without the concurrent production of voluminous clouds of poisonous smoke. For half a century mechanical ingenuity has been exhausted in striving to remove or mitigate these evils. Enough has been written to prove the utter inefficiency of the present means of burning raw coal, until the conviction has now been established that that method is irremediably wrong.

COMPOUND COMBUSTION.

The general adoption of its correlative will enable the enormous annual loss resulting from the present wasteful use of coal to be almost entirely avoided by the expedient of placing fuel in a closed chamber, and maintaining it at an incandescent heat by forcing in a supply of air, the oxygen of which combines with the fuel to form what is generally called—for want of a better or exact definition—producer gas. The formation of this gas is but a preliminary step toward complete utilization of the fuel, and its generation by incandescent heat is referred to as primary combustion. This subdivision in the generation of heat marks its divergence from the present wasteful practice, and emphasizes the means of attaining the consummation now under review, viz : —complete combustion without smoke. This preliminary transformation of solid fuel into combustible gas is simple and complete. Its chief peculiarity lies in the fact that all the fuel disappears from the closed chamber with the gas, and leaves no residue but clinky or other earthy matter.

THE GAS PRODUCER.

Passing for a moment from the immediate problem before us to a consideration of the closed chamber just referred to, which is known as the gas producer. Its proper construction is a matter of great moment in the all important point of smoke prevention—for it cannot be too thoroughly understood that once formed it cannot be annihilated. The chief provocative of smoke is the volatile hydrocarbons contained in all bituminous coal. That these are given off on the first application of heat is indicated by the appearance of smoke ; hence it is of the first importance that this chamber, or gas producer, be constructed to transform these hydro-carbons into permanent or fixed gas, and this can be assured by causing them, in a properly formed structure, to pass through the heated body of fuel before they escape to the outlet pipe or gas main.

Having thus traced the preliminary part of this process for treating coal, the next step claims attention. This consists of oxidizing the producer gas with the oxygen contained in air, or, in other terms, by mixing producer gas with air and igniting them, secondary combustion takes place, resulting in a temperature of about 3,500 deg. F., without smoke. This result is best accomplished in a combustion chamber specially constructed of fire brick, which becomes red hot, and tends to maintain a constant equable temperature, although this is of lesser moment when the air supply is already warmed by radiant heat from the producer, which can be surrounded with an air casing constructed of thin iron plates for this purpose.

This supply of heated air should be admitted through a grating, or regulating valve, so that the requisite amount only be admitted to the gas to insure the best results ; also, a sight-hole is usually provided to afford inspection of the interior of the combustion chamber, so that these ends may be fully attained. Simplicity may be said to characterize this process, and this designation applies equally to the structure or plant as well as to its manipulation. The generation of gas and also its combustion are under instant and complete control, being regulated, in each case, simply by the admission of air. The entire process is simple, safe, and efficacious, requiring neither elaboration of plant, nor skilled labor. A wide range has already been afforded to the employment of

GAS FUEL.

Commencing with the splendid achievements of the late Sir W. Siemens in its application to metallurgical purposes, it has gradually been adopted for other industries requiring calorific intensity, until the principle has become familiar to many leading manufacturers, and its special suitability to steam boilers fully recognized. In this capacity a double economy is conferred, since it demands less labor and less coal, without necessarily increasing the first cost over ordinary boilers. Practical results are attained that place gas firing in an unassailable position as a simple means of perfecting combustion, and also a rational solution of the pestilential smoke problem. Several of these results have already been given in this journal, and it is intended to supplement the principles and practice then published by now supplying diagrams of a steam boiler combined with producers for supplying the gas, so that these means of attaining the economies now under consideration may be fully understood, and their general acceptance thereby facilitated, to the pecuniary benefit of manufacturers, and the sanitary improvement of bleach greens and other cognate industries.

MECHANICAL DRAUGHT.

With the abolition of smoke, the disappearance of chimneys may be reasonably anticipated, as the air supplied to furnaces no longer depends upon induced draught, but is supplied by mechanical pressure. It is generally asserted and believed, that from one-quarter to one-half the total available heat of boilers passes away to the chimney. During some steam trials conducted by government experts on the 9th of November, 1889, the temperature of escaping gases in the chimney frequently exceeded the limit of the thermometer then used, viz., 860 degrees F., thus showing how immense volumes of heat are lost, even under favorable circumstances and careful management.

LOSS OF HEAT IN CHIMNEYS.

There are many common errors as to chimney temperature, one of which is that a high temperature therein argues a considerable loss of heat from the furnaces ; but this does not by any means necessarily follow, for, if the combination of fires be imperfect, a large proportion of the gases pass away unconsumed, with the effect of lowering the funnel temperature ; but, on the other hand when the gases become thoroughly consumed a much larger amount of heat is generated, and, though the chimney temperature may be higher, yet a very much larger relative proportion of heat gets into the boiler to perform useful work. The temperature in a furnace in which incomplete combustion is taking place—that is, in which a proportion of the gases passes away in the form of carbonic oxide—may be, say, 2,000 deg. F., and the chimney temperature 500 deg. F. If the combustion is then completed, and the carbonic oxide instead of escaping becomes converted into carbonic acid, the furnace temperature may rise to 3,000 deg. F., and that of the chimney to 800 deg. F.

CHIMNEY GASES.

The Research Committee on marine engine trials have recently issued tables giving an analysis of chimney gases which show them to consist (approximately) of

Carbonic acid	10
Oxygen	10
Nitrogen	80
	100

while their temperature varied from 500 deg. F. to 800 deg. F., and as the whole of this heat passed away through the chimney, it was entirely lost. An American writer has remarked : "That the time is approaching when tall chimneys will serve no more useful purpose than that of monuments to the folly of their builders."

CHIMNEYS ABOLISHED.

This aspiration is now realized in a startling manner by a very simple device in connection with gas producers, which heralds a new era in the history of combustion. It is the advent of a

discovery that enables part of the waste gases being revivified, and so converted again into combustible matter, in addition to the abolition of smoke. To make clear these simple means of utilizing waste heat and restoring chimney gases to a combustible condition, it will be necessary to explain how the principal combustible ingredient—carbonic acid—is first made.

In the ordinary gas producer, as is well known, air is admitted to support primary combustion by its oxygen combining with the fuel to first form carbonic acid ; this (non-combustible) gas then passes through the superincumbent fuel within the producer, where it absorbs more carbon, and so becomes the potent combustible, carbonic oxide. The gas is then led to a combustion chamber lined with fire brick, when secondary combustion will take place on the admission of air, resulting in a temperature of about 3,500 deg. F. without smoke.

By now referring to the composition of the waste chimney gases, as given above, it will be clearly understood that, by abstracting from them the incombustible carbonic acid and returning it through the hot fuel of the producer, it absorbs more carbon, and agains becomes the potent combustible, carbonic oxide.

UTILIZATION OF WASTE HEAT.

By this simple and expedient method, much of the waste heat is also returned to the producer with the carbonic acid and profitably employed. The distinguished characteristic of gas firing is the absence of smoke ; and by utilizing a portion of the waste gases as indicated above, no chimney will be required, as the air to maintain combustion is supplied at a pressure, so that a moderately sized outlet pipe only is necessary for dispersion of the remaining waste gases. By this system no chimney is necessary, either for creating a draught to induce a flow of air to the furnaces, or as a conduit for smoke. The only exit pipe required for the waste products of combustion may be compared to the exhaust pipe from a large gas engine, and it may be lead through a wall into an open space, or conducted to the roof of the boiler house.

GASEOUS FUEL

is thus shown to be an economical method of realizing the maxima amount of heat from fuel by a system that has been designated compound combustion, because it rationally converts the solid into the gaseous state by primary combustion, and then completes the process by secondary combustion. It is characterized by the entire absence of smoke, useful effect from all volatile hydro carbons is secured, no coke or cinders are deposited, and by revivifying a portion of the waste gases, the chimney, or at least that towering structure for dissipating heat, may be finally dispensed with.

That this beneficial process entails less expenditure for original cost, working expenses and maintenance than ordinary steam boilers, is worthy of serious consideration by those who sustain our national industries, often in the face of keen competition both at home and abroad. In those interests the principles, practice, and experience gained by its use have already been set forth on various occasions in the pages of this journal, and it is with the same regard for legitimate and well-directed economy that attention is again directed to a channel for securing the utmost benefits from—while rejecting some of those adverse conditions that have too long characterized—the combustion of coal.

REPAIRING INCANDESCENT LAMPS.

A FRENCH engineer (M. Pauthonnier) has devised a process of repairing incandescent lamps quickly and economically, that is, a broken or worn out filament is renewed. The French technical journals declare that the process is really practicable, and saves money. *L'Electricien* says that the process is to be introduced into the United States at once, and on an extensive scale. The London *Electrical Engineer* observes that the attempts have been made to render the repair of broken filaments a practical trade, and, in reference to the Pauthonnier process, says that the life of the repaired lamp is at least equal to the original

The process gone through is as follows :

The glass-blower takes the lamp and makes at the top a hole large enough to admit a new filament. The lamp thus opened is passed to a girl, who, by means of special nippers, cuts the broken filament, which she removes, being careful to leave on each platinum support about one millimetre (about one-twenty-fifth part of an inch) of filament. A second girl takes the prepared lamp and places it in a socket to which current is lead ; she then fills the bulb with a hydro-carbon l quid, and introduces a new filament previously standardized. By the aid of a pair of special pliers she touches the filament to one of the ends left, and turns on the current. The liquid becomes decomposed into hydrogen, which rises through the liquid, and into solid carbon, which is deposited upon the joint, firmly connecting the filaments together. The same is then done for the other end of the new filament. The next process is the cleaning of the glass bulb, which, it is stated, becomes, if anything, cleaner than the new lamps. The glass-blower then takes the lamp again, attaches a tube of glass to the opening made, and the repaired lamp is then exhausted, the process of exhaustion taking three-quarters of an hour, each pump carrying five lamps. The bulb is then closed in the usual manner. The different operations described are performed very rapidly, and form an elegant and practical process, and may be repeated many times. For "Sunbeam" lamps the process is easier still on account of the size, and may be performed either to replace filaments or to clean the bulb.

ELECTRICAL ENTERPRISE IN MANITOBA.

MR. Wm. Bathgate, of the Manitoba Gas and Electric Light Company, recently invited the members of the city council to the works of the company in Winnipeg.

The boiler house is 70 ft. long by 40 ft. wide. There are nine steel boilers of 740 h.p. One hundred pounds of steam is carried. The smoke-stack is 100 ft. high, and five ft. in diameter. The engine and dynamo house is 80 ft. square and contains two pairs of compound surface condensing Brown automatic engines of 200 and 400 h. p. respectively. The driving wheel of the 400 h. p. engine weighs 16½ tons, and is 18 ft. in diameter and 40 inches face, and drives the largest belt that has been made in Canada —three ply, 3 ft. 4 in. wide and 88 ft. long. The shafting with which it is connected is fitted up with friction clutch pulleys made by the Vulcan Iron Company, from which are run two Thomson-Houston arc machines for city lighting and one 1,000-light incandescent dynamo, with space for two more large incandescent dynamos. Three incandescent dynamos of 2,000 light capacity are run from the shafting, driven by the 200 h. p. engine as well as the arc dynamos which are used for private lighting. The total capacity of arc plant is 125 lights, 2,000 c.p.; the total capacity of incandescent plant is 3,000 lights, 16 c.p., with capacity for two more incandescent machines of 2,500 lights, to be installed this fall. The pumps in connection with each engine consist of one Blake air pump, one circulating pump, one duplex boiler feed pump, and one large Northey auxiliary pump fitted up with 100 feet of 2-inch hose for fire protection pnrposes—all driven by steam. The workshop contains a 7 h.p. Otto gas engine furnishing power for blacksmith and machinery shops, which are fitted with two lathes, one 15 foot and one 14 foot bed, screw cutting machines, emery wheel, grindstone, drills and punching machines, all the necessary repairs for both gas and electricity, being done in these shops.

A GOOD SHOWING FOR ELECTRICITY.

CHIEF Inspector McDevitt, of Philadelphia, makes the following statement in his report to the underwriters :

"There are over 5,000 buildings in Philadelphia wherein electric currents are used for light and power purposes. Of this number, 287 buildings (seven of which are dwellings) have their own apparatus, the latter varying in size from a 20-light to one of 4,000 lights. The number of lights furnished by these private plants aggregates 80,258 incandescent and 3,325 arc lights. One retail store contains 482 arc lights. There are fifteen public stations distributing electric currents to all sections of the city, furnishing thousands of lights and power to dwellings, churches and other classes of buildings. The number of lights supplied by these respective stations varies from the small station furnishing 2,000, to the Edison, which furnishes over 40,000 incandescent lights, and current for a large number of motors. The electric motors in use are of a capacity ranging from one-eighth to thirty horse-power (being used to a great extent as a substitute for laborious hand or foot-power in dwellings and small workshops), and are being rapidly introduced as a more ready motor in place of steam and hydraulic power in propelling machinery. No insurance loss occurred in any building in our city during the past year from fire where the cause could be in any way attributed to the electric wires."

SPARKS.

The town of North Bay, Ont., is shortly to be lighted by electricity.

The question of electric lighting is being considered by the towns of Milton and Acton, Ont.

The village of Creemore, Ont., will soon be in the enjoyment of arc and incandescent electric light.

The directors of the Fort Wayne Electric Co. have declared a dividend of 75 cents per share to stockholders.

The municipal authorities of Lachine, Que., have entered into a contract with Mr. A. J. Corriveau, of Montreal, to light the town by electricity.

The New Brunswick Electric Light Company has just closed a bargain to supply the city of St. John with 125 arc lights, which are to be in operation in six weeks.

The Canadian Pacific telegraph line is now completed to the boundary at Sumas, and one wire is in operation from Seattle, Wash., through to the Canadian Pacific main line.

Joseph Pelletier, an employee of the Standard Electric light Company, Ottawa, while working on the top of a 50 foot pole missed his hold and fell to the sidewalk. He died while being conveyed to the hospital.

The Edison General Electric Company (Canadian district) have moved into their new warehouse, "The Edison Building," 77 Bay Street, Toronto. The offices are very conveniently arranged and nicely fitted up, and when their display room is completed, they will have quite an elaborate display of electrical apparatus.

The following is the rule for calculating the amount of exciting power that is required for an electro-magnet pulling at its armature, in the case where there is a closed magnetic circuit with no leakage of magnetic lines. Take the square root of the pounds per square inch; multiply this by the mean total length (in inches), all round the iron circuit; divide by the permeability, and finally multiply by 2,661; the number so obtained will be the number of ampere turns.

The Vancouver Coal Co. has ordered a complete electric plant for mining purposes, consisting of an underground tramway with power sufficient to maintain a speed of eight or nine miles per hour with 150 loaded cars constantly moving. There will be 600 incandescent lamps for use in the under-ground workings, and the drills and cutting machines will also be operated by electricity. The plant will cost between $50,000 and $100,000. This is understood to be the first introduction of electricity for mining purposes in Canada. The Edison Company are supplying the outfit.

We take pleasure in directing the attention of those engaged in electrical enterprises in Canada to the advertisement of the Vulcanized Fibre Co., which appears for the first time in the pages of this number. The Company began the manufacture of vulcanized fibre about ten years ago. The material is produced by treating specially prepared vegetable fibre with powerful chemical agents, whereby the exterior portion of each separate fibre becomes glutinous, and while in this condition the whole mass is consolidated under very heavy pressure and becomes practically homogeneous. After this the chemicals are extracted, the mass is manipulated, rolled, pressed, and cured by various methods. It is designed for use in railway, electrical and general mechanical work, and is said to be an excellent insulator for dry positions.

A project is on foot, the object of which is to hold a union pic nic under the auspices of Toronto and Hamilton branches, Canadian Society Stationary Engineers, on Dominion Day. Oakville will probably be selected as the location. It is hoped that London, Brantford and Stratford Branches will also be well represented on the occasion. There is nothing like a dinner or pic-nic to promote acquaintanceship and indirectly the welfare of the Association. Here's to the pic-nic.

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TORONTO ELECTRICAL WORKS

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SPARKS.

The Royal Electric Co., of Montreal, have generously donated a 10 light arc dynamo to McGill University for use in the electrical engineering department.

The arc light plant installed by the Edison General Electric Co. at Niagara Falls, was started up last week, and is pronounced by the local company an unqualified success.

The Edison General Electric Company have moved their works to Peterboro', and expect to get their machinery in operation about June 1st. They will employ a staff of about 500 men.

The Edison General Electric Company have closed contract with Hector McRae, Ottawa, for an electric percussion drill and hoist for use in his phosphate mines in Templeton. The plant will probably be in use in June.

The Edison General Electric Co. have recently closed a contract with the Winnipeg Street Rail-Co. for 100 h. p. generator and four extra car equipments. It is expected that this plant will be in operation about June 10th.

The Edison plant installed in the Ontario Rolling Mills at Hamilton, Ont., consisting of ten 2000 c. p. arc lamps and 135 incandescent lamps, is running very successfully, and the new arc system is pronounced a decided success.

The Eastern Electric Co., of St. John, N. B., operating Edison system, are making very rapid progress. They have already over three thousand lights in operation, and have recently added two 750 light Edison dynamos to their equipment.

The Royal Electric Co. report the following business for the past month: Sold the Roberval Hotel Co., Lake St. John, Que., a 300 light incandescent dynamo and a 15 arc light plant; the Sherbrooke Gas & Water Co., one 500 light alternating incandescent plant; the St. John Gas & Electric Light Co., of St. John, N. B., one 1200 light alternating incandescent plant; the St. Johns Electric Light Co., St. Johns, Nfld., one 30 light arc plant; R. B. Angus, of Montreal, for his residence at St. Annes, Que., one 50 light plant. On their large order for the Standard Electric Co., of Ottawa, they have installed and started successfully one 1500 light alternating plant, with one 80 H.P. generator, and several motors of different sizes. They have completed the installation in the Vancouver Opera House, Vancouver, B. C.; started up and completed a 300 light alternating plant at Moose Jaw, N.W. T.; installed for the Standard Shirt Co., of Montreal, one 30 light incandescent plant, and motors in the following places:—Sun Life Assurance Co., Montreal, 10 h.p. for passenger elevator; H. Burks & Co., 2 h.p.; J. D. Anderson & Co., clothiers, Montreal, 3 h.p.; D. Walker, Montreal, 3 h.p.; Joseph Fortier, stationer, Montreal, 5 h.p.



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MONTREAL.

THE DIFFERENCE BETWEEN VOLT AND AMPERE.

THE following question was put to Thomas A. Edison in a recent law suit, in answer to which Mr. Edison gives a pretty clear definition of the words "ampere" and "volt":

Q.—Explain what is meant by the number of volts in an electric current?

A.—I will have to use the analogy of a waterfall to explain. Say we have a current of water and a turbine wheel. If I have a turbine wheel and allow a thousand gallons per second to fall from a height of one foot on the turbine, I get a certain power, we will say one horse-power. Now, the one foot of fall will represent one volt of pressure in electricity, and the thousand gallons will represent the ampere or the amount of the current; we will call that one ampere. Thus we have a thousand gallons of water, or one ampere, falling one foot or one volt, or under one volt of pressure, and the water working the turbine gives one-horse power.

If, now, we go a thousand feet high and take one gallon of water and let it fall on the turbine wheel, we will get the same power as we had before, namely, one horse-power. We have got a thousand times less current or less water, and we will have a thousandth of an ampere in place of one ampere, and we will have a thousand volts in place of one volt, and we will have a fall of water a thousand feet as against one foot. Now, the fall of water or the height from which it falls is the pressure or volts in electricity, and the amount of water is the amperes. It will be seen that a thousand gallons a minute falling on a man from a height of only one foot would be no danger to the man, and that if we took one gallon and took it up a thousand feet and let it fall it would crush him. So it is not the quantity or current of water that does the damage, but it is the velocity or the pressure that produces the effect.

FLUME AREA.

THE fraction of a square foot of orifice required for the discharge of a given number of gallons of 231 cubic inches each, under any desired head, in any given number of minutes, is found by dividing the number of gallons by 2265 times the number of minutes and by the square root of the head in feet. The table here given shows how much orifice will be required to discharge one gallon per minute, under various heads in feet.

HEAD FEET	SQ. FT. HEAD.	AREA SQ. FEET.	HEAD FEET	SQ. FT. HEAD.	AREA SQ. FEET.
½	.707	.00062	16	4.	.00011
⅜	.866	.00059	17	4.123	.000107
1	1.	.00044	18	4.243	.000104
2	1.414	.00031	19	4.359	.000101
3	1.732	.00025	20	4.472	.000098
4	2.	.00022	21	4.583	.000096
5	2.236	.00019	22	4.694	.000093
6	2.449	.00018	23	4.796	.000092
7	2.646	.00016	24	4.899	.00009
8	2.828	.00015	25	5.	.0090883
9	3.	.000147	26	5.099	.000086
10	3.162	.000139	27	5.196	.000085
11	3.317	.00013	28	5.292	.000083
12	3.464	.000129	29	5.385	.000082
13	3.606	.00012	30	5.477	.00008
14	3.742	.000118	31	5.567	.000089
15	3.873	.000115	32	5.656	.000078

—Power and Transmission.

PERSONAL.

It is stated to be the intention of the Dominion Government to appoint Mr. John Dodds, of Kingston, to the position of steamboat inspector as the successor of Mr. O. P. St. John, whose resignation was noted in the ELECTRICAL NEWS for May.

The genial presence of Mr. H. M. Grant, general travelling agent of the Vulcanized Fibre Co., of Wilmington, Delaware, illumined for a brief space the other day the ELECTRICAL NEWS sanctorum. Mr. Grant visits Canada quite frequently, and finds among the electrical people of this country an ever widening constituency for the sale of the well-known insulating material manufactured by his company.

NOTES.

The first electric elevator to go into operation in Ottawa has been installed in the Russell House annex.

Mr. A. M. Wickens, President of the Executive Board of the Canadian Association of Stationary Engineers, was a visitor at the regular meeting of Hamilton Branch No. 2 on the 15th inst., and reported the result of the work of the Legislative Committee. Mr. Wickens also gave to the members a short talk on Electricity.

A valve for steam or water has been patented in Canada by Mr. Thos. Riley, of Toronto, Ont., on the 19th of January, 1891 (No. 35827). This invention consists of a removable seat of the valve; a washer is placed between these two seats; a cushion is placed on the spindle of the valve supported by a permanent plate. Above this plate is a recess in which a washer is forced to prevent leaking.

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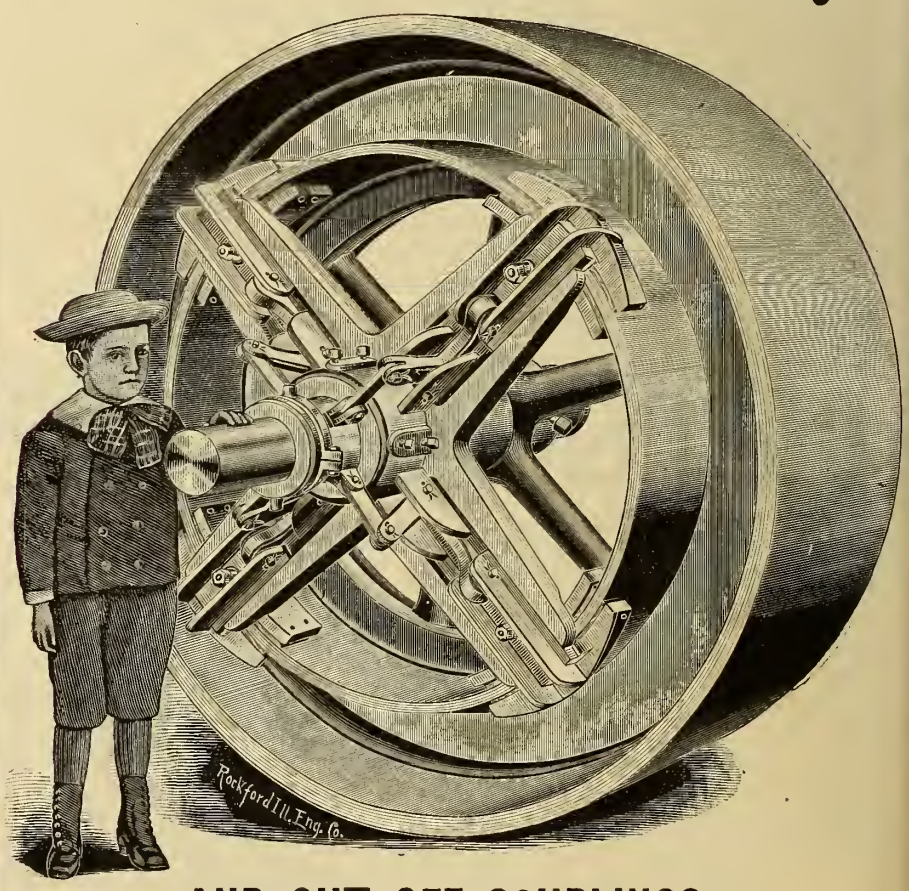
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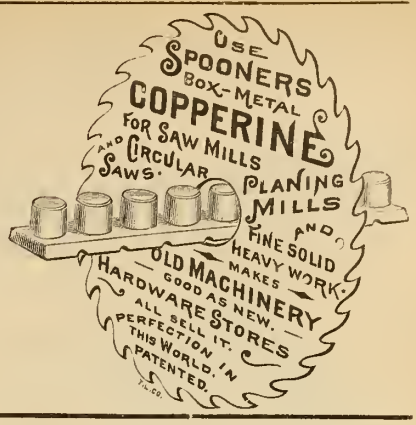
COPPERINE

Superintendent's Office, Water Works Dep't,
TORONTO, January 6th, 1891.

ALONZO W. SPOONER, ESQ.,
Port Hope, Ont.

DEAR SIR: I am pleased to say that after nearly three years' constant use day and night, on our largest engine, your Copperine has stood its work well. I have not had to renew any of the heavy bearings yet, so I consider that speaks for itself. I am pleased to recommend it to any one in need of metal to stand heavy work.

I am, yours truly,
J. C. FERGUSON,
Chief Engineer Toronto Water Works.



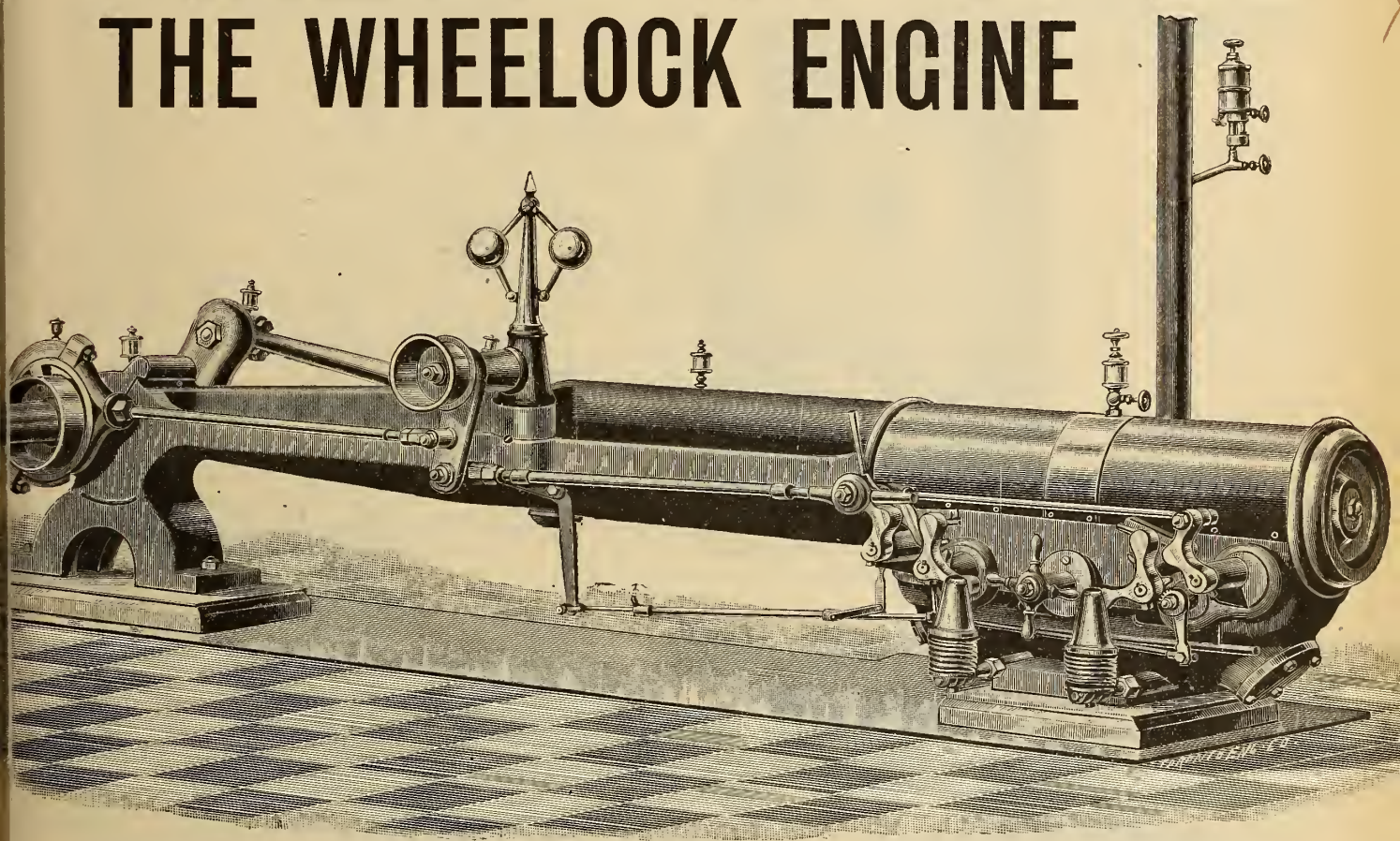
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Fredericton Electric Light Co.	Fredericton, N. B.	Stratford Gas Co.	Stratford, "
Halifax Gas Co. (2 engines)	Halifax, N. S.	Reliance Electric Light Co.	Waterford, "
Oshawa Electric Light Co.	Oshawa, Ont.	Arnprior Electric Light Co.	Arnprior, "
Guelph Gas Co.	Guelph, "	Corporation of Town of Mitchell	Mitchell, "
Berlin Gas Co.	Berlin, "	Portage La Prairie Electric Light Co.	Portage La Prairie, Man.
Galt Electric Light Co.	Galt, "	Corporation of Town of Collingwood	Collingwood, Ont.
Corporation of Town of Orillia	Orillia, "	Corporation of Town of Picton	Picton, "
Belleville Gas Co.	Belleville, "	Kincardine Electric Light Co.	Kincardine, "
Brockville Gas Co.	Brockville, "	Palmerston Electric Light Co.	Palmerston, "
T. Eaton & Co. Electric Light Station (2 engines)	Toronto, "	Strathroy Electric Light Co.	Strathroy, "
Renfrew Electric Light Co.	Renfrew, "	Corporation of Village of Markham	Markham, "
Brockville Incandescent Electric Light Co. (2 engines)	Brockville, "	Hagersville Electric Light Co.	Hagersville, "
Metropolitan Electric Street Railway Co. (compound)	Toronto, "	Pembroke Electric Light Co.	Pembroke, "
Leamington Electric Light Co.	Leamington, "	Niagara Falls Electric Light Co.	Niagara Falls, "
Ball Electric Light Co. (2 engines)	London, "	Full Electric Light Co.	Charlottetown, P.E.I.
Woodstock Electric Light Co.	Woodstock, "	Preston Electric Light Co.	Preston, Ont.
Cobourg Electric Light Co.	Cobourg, "	Listowel Electric Light Co.	Listowel, "
Orangeville Electric Light Co.	Orangeville, "	Lindsay Electric Light Co.	Lindsay, "
Mount Forest Electric Light Co.	Mount Forest, "	Winnipeg Electric Street Railway Co.	Winnipeg, Man.
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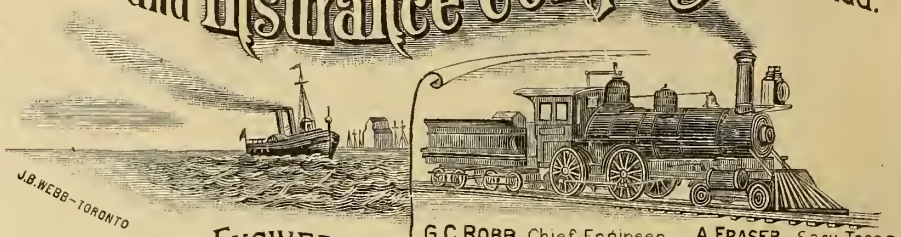
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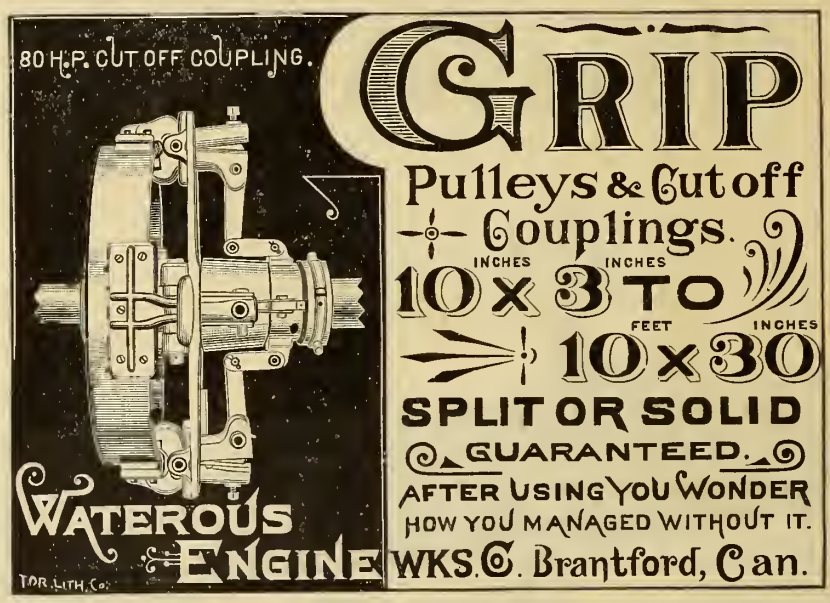
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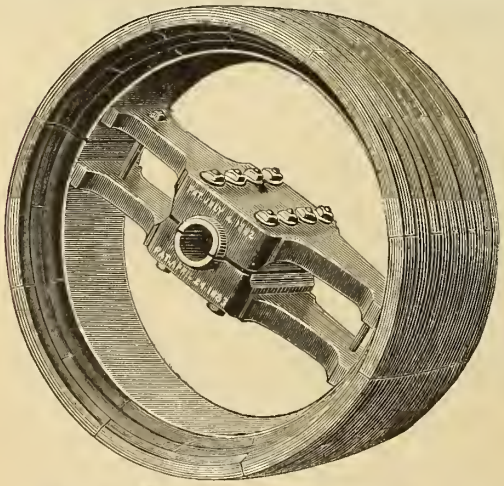
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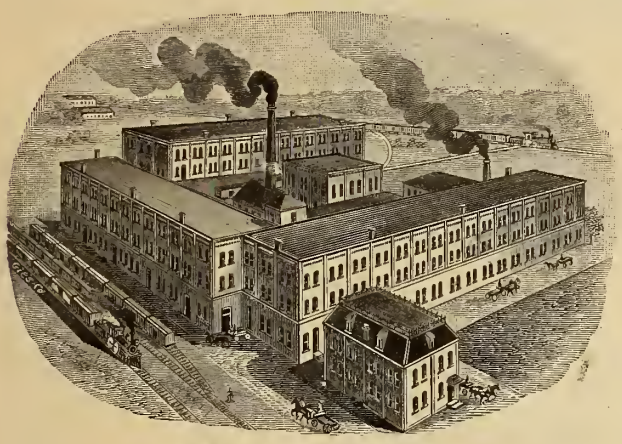
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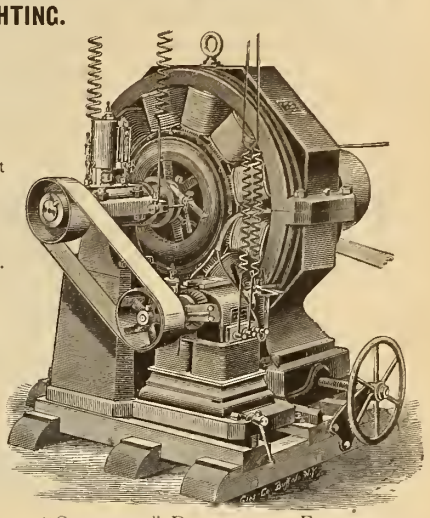
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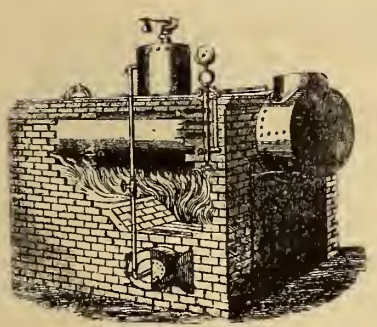
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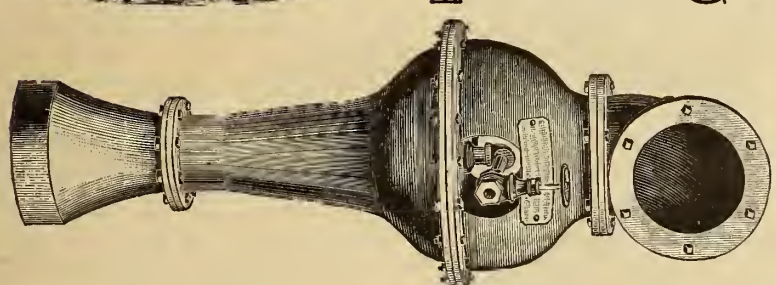
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CANADIAN PATENTS:
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U. S. PATENTS:
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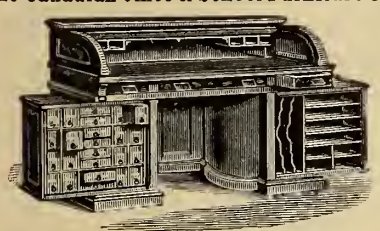
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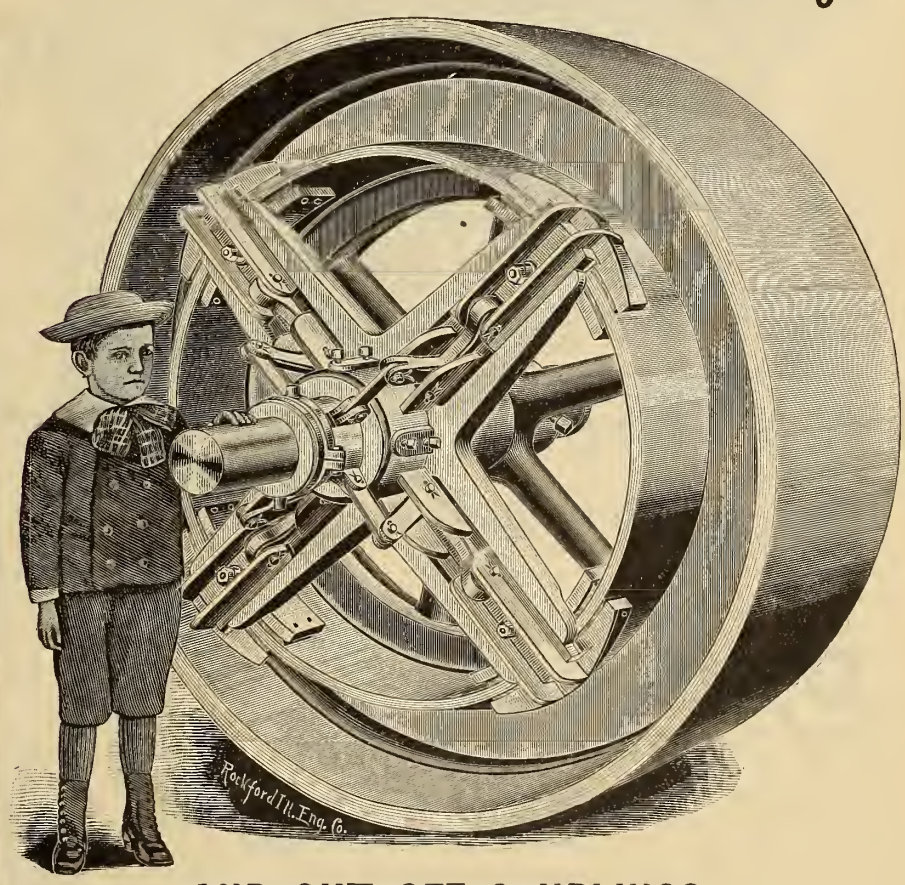


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ESTABLISHED 1869

SPARKS.

Song of the electric light company—"Ohm, Sweet Ohm."

A new metallic telephone circuit is under construction between Toronto and Peterborough.

The Bell Telephone Co. have purchased a cable with which to connect Toronto Island to the city. The cost of the undertaking will be about $6,000.

Work is being pushed rapidly forward on the new Ottawa Electric Railway, which will be equipped with Westinghouse gearless motors and other appliances.

It is understood to be the intention of the Edison Co. to erect stations in various parts of the city of Montreal for the supply of current for incandescent lighting and power purposes.

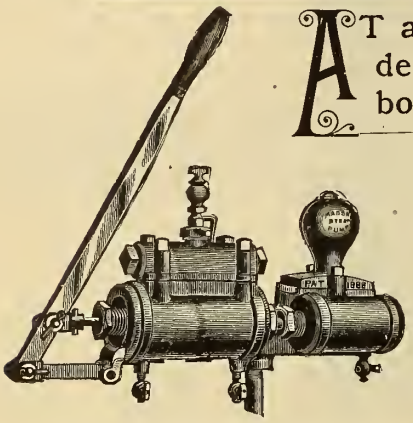
Mr. Stillwell, manager of the Electrical Manufacturing Company, of Hamilton, has interviewed the Hon. Mackenzie Bowell to ask for an increase in the duties on imported incandescent electric lamps, the lamps now being manufactured in Canada.

Through experiments made by English military authorities it has been found that whenever the atmosphere is laden with smoke or mist the power of an electric light is greatly diminished by crossing the beam of light by that of another at a certain angle. At the point of intersection the illuminated space is practically made a screen. It is proposed to utilize this knowledge, since the electric beam can thus be made to serve as a screen, back of which tactical operations might be conducted in secret.

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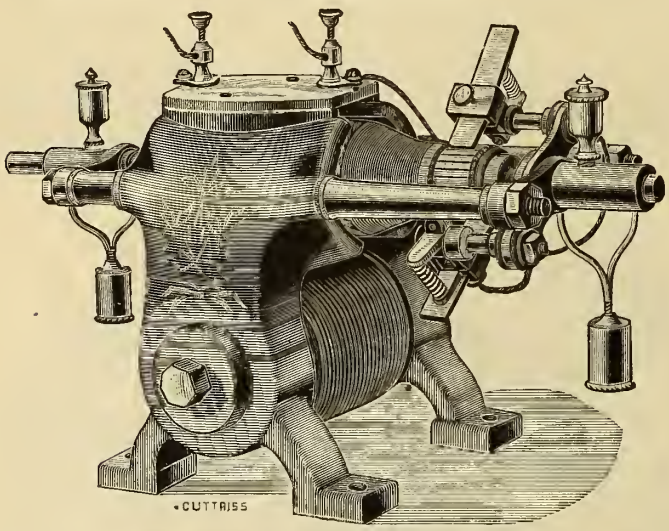
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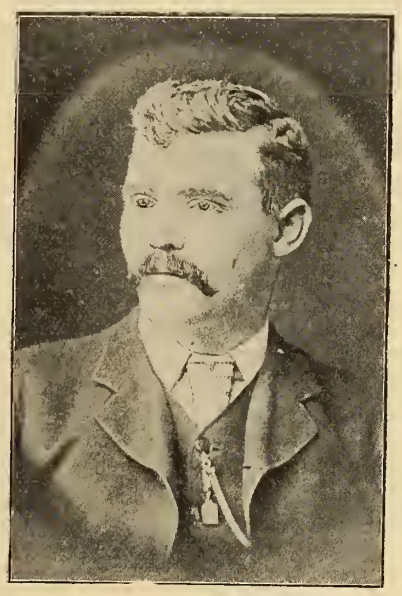
MR. JAMES BAIRD.

THE accompanying portrait is designed to make familiar to our readers the features of another engineer who is deemed worthy of a place in the ELECTRICAL NEWS portrait gallery, viz., Mr. James Baird, President of the Canadian Marine Engineers' Association.

Mr. Baird, who is about 30 years of age, was born in the "land of brown heath and shaggy wood," and served his apprenticeship in "Glasgow town." He was employed for some time as engineer in the merchant marine. Five or six years ago he came to Canada and to the city of Toronto, and by the way, since coming, has succeeded in pursuading a fair daughter of the Dominion to unite her fortunes with his.

About three years ago Mr. Baird became a member of the Canadian Marine Engineers' Association. The active interest which he manifested in its welfare led to his appointment last year to the office of vice-president, and to his promotion this year to the position of chief executive officer of the organization.

Mr. Baird is employed as chief engineer of the Steamer "Africa," which is engaged in the lumber trade between Parry Sound and Buffalo.



MR. JAMES BAIRD.

STEAM ADMISSION.

II.

HAVING determined that the steam pipe is large enough to keep up the boiler pressure or very near that pressure at the speed the piston is to travel, the next point to examine is the size of the steam chest or valve chamber. In some engines the chamber that contains the valve is made so small relatively to the size of the valve, that the steam cannot freely pass the valve to enter the ports. In some slide valve engines the steam can enter the end of the cylinder quite freely, but the valve seriously obstructs its passage to the other end. This sometimes explains the fact that a fairly good diagram can be got from one side of the piston and a very poor one from the other.

The port for the admission of the steam should be at least as large in area as the steam pipe. If the same port is used for the discharge of the exhaust steam it should be larger. How much larger, is a point upon which engine designers differ, but if made of such size that the steam when passing out as exhaust need not travel faster than seventy feet per second, good results will be obtained. From the rule given for the size of the steam pipe, the exhaust passages and pipe may be obtained by simple proportion, making the statement thus: as forty-two is to sixty, so is the *area* of the steam pipe to the *area* of the exhaust pipe and of the exhaust parts. Having the valves and the ports of the right size, the valves should be made to open and close the passages as quickly as possible. One method of doing this is to make the port as wide as possible, so that a small movement of the valve will open a large area. Another method is to make what is usually called a grid-iron valve, that is, having two or more openings into the main port. For example, in a cylinder eighteen inches diameter, and requiring a port twenty-seven inches in area, the port might be made eighteen inches wide by one inch and a half in the direction of the travel of the valve. To open this fully the valve must travel one inch and a half, but if two openings be made, each three-fourths of an inch, then the valve need only move half the distance, and if six openings be made, a travel of *one*-quarter of an inch will open as full a port as in the first case required one inch and a half. In high speed engines and engines cutting off steam automatically, this is a very important element, as it is necessary to get the steam into the cylinder as quickly as possible and then close the valve sharply. Take an engine making 120 revolutions per minute and cutting off steam at one quarter of the stroke, in what time must the steam valve open and close again? At 120 revolutions per minute, two revolutions are made in each second. In order to make a revolution, two steam valves have to be opened and closed, this reduces the time for each to one-quarter of a second if carrying steam full stroke, and when cutting off at one-quarter stroke the whole operation of opening the steam valve and closing it again must be done in one-sixteenth of a second.

Automatic cut-off engines of large size often make 80 revolutions per minute, and cut off as early as one-sixth of the stroke. When thus running there are 160 valve openings per minute, and as the cut-off is at one-sixth of the stroke, the valve must open and close in the one-nine hundredth and sixtieth part of a second.

The necessity for large steam pipe, plenty of port area, and a quick movement of the valve apparatus is clearly seen, when the time for the admission of the steam into the cylinder is taken into account. The importance of having the valve set to open exactly at the right instant in relation to the position of the piston is made plain by this way of looking at the matter.

It is found to be good practice to have the steam valve begin to open before the piston is quite to the end of the stroke. In slide valve engines many engineers set the eccentric so that the steam port will be about one-sixteenth of an inch open when the crank is on the dead centre. This early admission of steam forms a cushion, and takes up all the slack motion in the moving parts, before they begin to reverse their motion, and so prevents pounding or knocking.

It is difficult to get the position of the eccentrics and valve gear so as to give the exact amount of lead to the valve, because when set the engine is cold and there is no strain on the parts. A useful and practical rule is to allow one-sixteenth of an inch for each joint between the eccentric block and the valve. That is if there are two joints in the rod, the valve when cold would be set with one-sixteenth of an inch lead for each joint and for actual lead, making apparently one-quarter inch of lead. When engine is running the lead will only be about one-sixteenth of an inch. Where a grid-iron valve is used, the lead may be divided among all the openings or made to be at only one of them.

SAFETY VALVES—THEIR HISTORY, ANTECEDENTS, INVENTION AND CALCULATION.

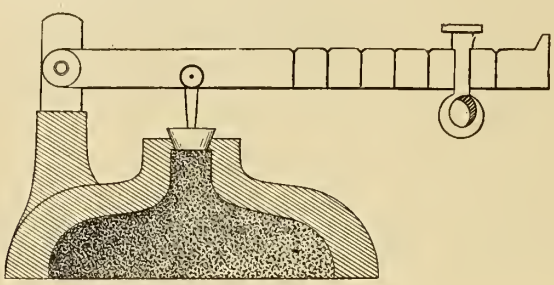
By William Barnet le Van.

It is due to Papin to state, that no one whose labors have produced so many important results, has in his writings shown so little of the vanity and absurd enthusiasm proverbially characteristic of an inventor. He is considered by his countrymen to be the true inventor of the steam engine, a claim strongly contested by some English authors of eminence who have written on the subject. The claim of his countrymen is based on communications by Papin to the *Acta Eruditorum* of Leipsig, in 1685. One of these is a description of a new machine to raise water, which is further noticed in the same journal in June, and again in the August following; and in the *Nouvelles de la Republique des Lettres* for July, 1687, is a reply by Papin to some objection raised against this apparatus by M. Nuit.

In 1687 Papin was appointed Professor of Mathematics at Marburg, in Germany.

Papin's claim to the invention of the safety valve, therefore, is not to the valve itself, but to the mode of applying it by means of a lever and movable weight, thereby not only preventing the valve from being blown entirely out of its place, but regulating the pressure at will, and rendering the device of universal application.

His safety valve consists of a conical valve, retained in its sit by a weight



Papin's Safety Valve, A. D. 1695.

on a lever; and from its resemblance to a steelyard, was called the "steelyard safety valve."

The ordinary commercial safety valve, as now made, is a disk with a bevelled edge, resting on a corresponding sit. The disk is kept down against the pressure in the boiler by external pressure variously applied, either by a weight acting with a leverage, or by a spring. This opening for the efflux of steam, created by the rise of the valve, is thus an annular opening. The opening through the valve must be understood to be the *effective* opening clear of bridges or other obstacles, and the area to be computed is the area of the smallest diameter of the valve As before stated, the valve is chamfered on the edge, which edge constitutes the steam-tight surface, and the effective area is what corresponds to the smaller diameter of the valve seat and not to the larger.

All boilers should have an extra or additional safety valve, of the same capacity as the other, which may act in case of accident to the first from getting jammed, or otherwise. When there are more than one boiler, a pair of safety valves in such a case must be put on each boiler.

Weighted safety valves are never employed on locomotives, and but seldom on steamships, as much steam is liable to escape during the oscillatory motions of the ship. Every safety valve should be so located that it can be opened by hand at least twice each day; or, if not convenient to so place it, a cord should be secured to the lever or stem of the valve so as to operate it as above, to keep the valve free and in good working order.

FORCE.

The subject of safety valves is wholly embraced in the static branch of mechanics.

STATICS.

Statics is the science of force in equilibrium, or at rest. It embraces the strength of materials, of bridges and of girders; the stability of walls, chim-

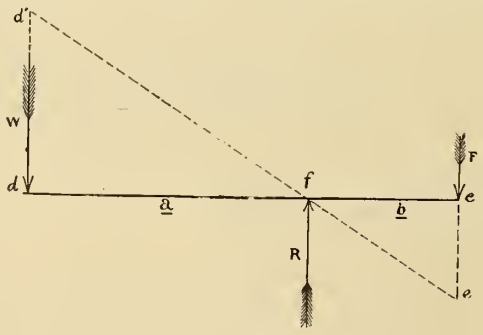


FIG. 2.

neys, steeples and towers; the static momentum of levers, with their combinations into weighing scales, windlasses, pulleys, furnicular machines, inclined planes, screws, catenaria, and all kinds of gearing.

FORCE.

The term *force* means any action which can be expressed simply by weight, and which can be realized only by an equal amount of reaction. Force is derived from a great variety of sources; but whenever it is simply force, it can invariably be expressed by weight, without regard to motion, time, power or work. The magnitude and direction of a force can be represented by a straight line; but no force can be realized without an equal amount of resistance in the opposite direction, which likewise can be represented by a straight line.

To illustrate: Let it be proposed to find the resultant of two parallel forces F and W, acting at the ends of an inflexible line *d e*.

Prolong the line W until *d d'* is equal to F, prolong F until *e e* is equal to W, then join *d'* and *e'*, which will cut the inflexible line at *f*. Draw from *f*

PROBLEM I.

the resultant R, equal and parallel to W+F; then R represents the magnitude and direction of the resistance which balances the two forces F and W. The distance $a=d\,f$ is the lever for the force W, and $b=f\,e$ is the lever for F, which quantities bear the following relation:

F : W = *a* : *b*, static momentums W *a* = F *b*.

STATIC MOMENTUM.

The product of a force multiplied by its lever is called *static momentum*. The resistance at *f* is called the *fulcrum*. It is supposed in this case that the forces W F act at right angles to the levers *a* and *b*. The lever of any force is equal to the right angular distance from the fulcrum to the direction of that force. When the static momentums W *a* and F *b* are equal, then the forces W and F are in equilibrium.

LEVERS.

Levers are classified into three different kinds with reference to the relative position of the force F, weight W, and fulcrum *f*.

When the fulcrum *f* is between the force F and the weight W, the lever is called the lever of the *first order* (Fig. 3).

When the weight W is between the force F and the fulcrum *f*, the lever is of the *second order* (Fig. 4).

When the force F is between the weight W and the fulcrum *f*, the lever is of the *third order* (Fig. 5).

The two forces F and W will be distinguished by considering F the applied force, acting on its lever L, to lift the weight W, acting on its lever *l*.

LEVERS OF DIFFERENT KINDS.

Algebrical and Geometrical expressions of the Fundamental Principles of Statics of Levers of different kinds.

PROBLEM II.

First Order.

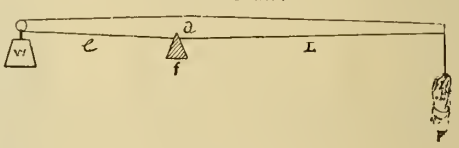


FIG. 3.

F : W = *l* : L, or F L = W *l*

$$F=\frac{W\,l}{L} \qquad W=\frac{F\,L}{l}$$

$$l=\frac{F\,a}{W+F} \qquad L=\frac{W\,a}{W+F}$$

PROBLEM III.

Second Order.

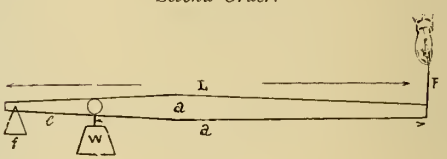


FIG. 4.

F : W = *b* : L, or F L = W *l*

$$F=\frac{W\,l}{L} \qquad W=\frac{F\,L}{l}$$

$$l=\frac{F\,a}{W-F} \qquad L=\frac{W\,a}{W-F}$$

PROBLEM IV.

Tdird Order.

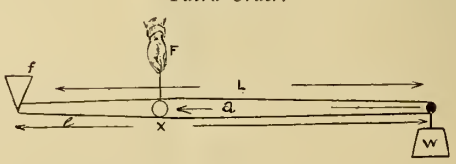


FIG. 5.

F : W = *l* : L, or F L = W *l*

$$F=\frac{W\,l}{L} \qquad W=\frac{F\,L}{l}$$

$$l=\frac{F\,a}{F-W} \qquad L=\frac{W\,a}{F-W}$$

This latter is the lever that is common to all safety valves now in general use on steam-boilers.

CENTRE OF GRAVITY.

The centre of gravity of a body, or of a rigid system of bodies, is a point in which, if they were suspended, the body will be in equilibrium in any position, like that of a wheel or circle-plane suspended in the centre.

A body suspended freely from any point *h*, will hang with its centre of

gravity in the vertical line $h\ k$. Now suspend the body from another point z, and the centre of gravity will be on the line $z\ m$; then when the centre of gravity is on both the lines $p\ o$ and $z\ m$, it must evidently be at g, where the two lines cross one another (see Figs. 6 and 7).



FIG. 6.

The lines $p\ o$ and $z\ m$, or the centre of gravity g, can also be found by balancing the body on a sharp edge. The centre of gravity of any figure or body is thus found by suspending or balancing the same in two different positions.

PROBLEM V.

In the foregoing (Figs. 3, 4 and 5), we have considered the levers to be inflexible lines without weight, which will answer when the centre of gravity of the material levers is in the fulcrum, like that of a weighing balance, or that of a wheel; but this centre of gravity is often located at a considerable distance from the fulcrum, as may be illustrated by Fig. 8, which is a lever of the first order, Fig. 3. The levers l and L are in the form of a beam resting on the fulcrum f, and its centre of gravity at g. Let the weights of the

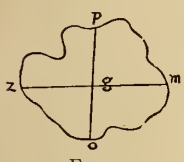


FIG. 7.

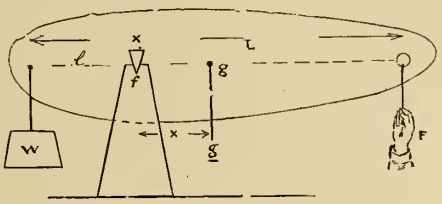


FIG. 8.

beam be represented by g, acting on the lever x; there will be two static momentums F L and $g\ x$, on one side of the fulcrum, against one W l, on the other side.

$$W\ l = F\ L + g\ x \qquad F\ L = W\ l - g\ x$$
$$g\ x = W\ l - F\ L \qquad W = F\ L + g\ x$$
$$F = W\ l - g\ x \qquad g = W\ l - F\ L$$
$$l = \frac{F\ L + g\ l}{W} \qquad L = \frac{W\ l - g\ x}{F}$$
$$x = \frac{W\ l - F\ L}{g}.$$

PROBLEM VI.

Fig. 9 is a lever of the third order, representing a safety valve as made and sold commercially.

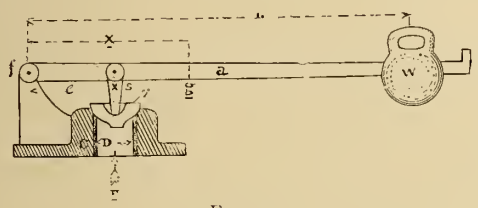


FIG. 9.

$$F\ l = W\ L + g\ x \qquad W = \frac{F\ l - g\ x}{L}$$
$$W\ L = F\ l - g\ x \qquad g = \frac{F\ l - W\ L}{x}$$
$$g\ x = F\ L - W\ L \qquad l = \frac{W\ L + g\ x}{F}$$
$$F = \frac{W\ L + g\ x}{l} \qquad x = \frac{F\ L - W\ L}{g}$$
$$L = \frac{F\ l - g\ x}{W}$$

The formulas above are the same as those for the lever of the second order (Fig. 8).

The centre of gravity g may be found experimentally by balancing the beam over a sharp edge, when the distance x can be measured from the fulcrum f. It is here supposed that the levers l and L are in a straight and horizontal line. The form of the beam affects the location of the centre of grevity g, as shown in Fig. 7; but when this centre is known, the shape of the beam does not affect the static momentums. The pressure on the fulcrum f is equal to W + g — F.

Fig. 10 will better show the different functions of a safety valve when in service on a boiler under steam pressure.

A safety valve consists, primarily, of a movable disk, ring or plate, held from without, in the majority of cases, by a weight or a spring, over an orifice in a containing vessel against the pressure of a fluid within, so that it will resist any required pressure to which it may be adjusted, at the same time that any greater pressure will move it away from its seat and permit some of the contained fluid to escape. In the case of a steam safety valve, the contained fluid is steam in contact with watee; the containing vessel is a steam boiler and the chambers and pipes in unobstructed communication therewith; and the office of the safety valve is to discharge all the steam which may at any time be generated within the boiler in excess of the steam drawn from it, after a certain pre-determined limit of pressure has been reached. Safety valves are generally circular or annular plates of brass or iron, with corresponding seats; and omitting as irrelevant many special forms, are of two classes:

First. Those which are held to their seats against internal pressure by weights, either acting directly or through levers; in most general use with stationary boilers.

Second. Those which are held to their seats against internal pressure by springs, either acting directly or through levers; used almost exclusively upon locomotives, and to a great extent on portable steam engine boilers.

The form of safety valves in general use to-day, as before stated, were used by Papin in 1680, and are, therefore, two hundred years old, and probably much older.

If the contact between a safety valve and its seat were the contact of two sharp edges, like two circular knives edge to edge, the action of a valve in opening and closing would be simpler than it can generally be in practice. In fact, the surface in contact must have, for constructive reasons, a breadth very considerable in proportion to the diameter of the orifice closed by the valve; and since the areas of circles are to each other as the squares of their diameters, the area of the circle circumscribed by the outer border of the valve seat is materially larger than the area bounded by the inner border of the seat. The smaller area alone, within the seat, is acted on by the confined steam while the valve is closed; the larger area, within the outer border of the seat, is acted on by the escaping steam while the valve is open. It was, therefore, not unnatural to suppose that a safety valve, once opened against a resistance nearly constant, would immediately open still more widely, so as to give free outlet to the steam; and that it would remain open until a very sensible reduction of pressure in the boiler should enable a force, at first overcome by the higher pressure on the smaller area, to overcome in its turn the reduced pressure on the larger area.

That the reverse is true is well known. A safety valve, opened so as to permit the escape of a thin film of steam, can be further lifted so as to permit the free escape of steam, only by considerable increase of pressure, or by some special contrivance. It is usual to explain this phenomenon entirely by the increased resistance of springs due to increased tension; but this cannot be the sole cause, since the same thing is observed in a less degree where weights are used to close the valve. An additional cause is to be found in the expansion of a film of escaping steam between the valve and its seat, as in the familiar "pneumatic paradox" described by Bourne as "the tendency which escaping steam has to suck the valve down." There is also a little sluggishness and hesitancy about a movement produced by a very slight preponderance of nearly balanced forces. All motion is attended with some friction and some inertia; and decided preponderance is required to produce decided movement. To counteract this inertness, and to give promptness and decision—in a word, to give "pop!" to the action of a safety valve, both in opening and closing, many expedients have been invented, and will be described further on.

Reference being had to Fig. 10, the letters denote as follows:

1. D represents the diameter of the valve chamber C, also the smallest point of contact of the valve v.

2. W represents the weight acting on the long lever L.

3. w represents the weight of the lever arm a, valve v, and stem s, acting on the lever x.

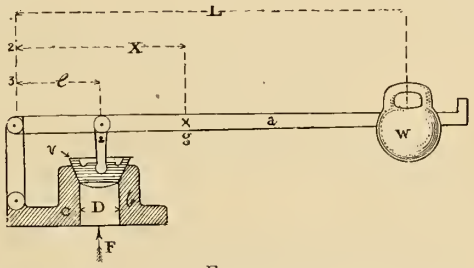


FIG. 10.

4. L represents the long lever, and is the distance from the centre of the weight W, to the fulcrum f, on which the lever arm a rests.

5. l represents the short lever, and is the distance from the centre of the valve stem s to the fulcrum f.

6. x represents the distance from the centre of gravity g, to fulcrum f.

7. f represents the fulcrum, and is the support on which the lever arm a rests.

8. a represents the lever arm, on which is placed the weight W, and to which is attached the valve stem s.

9. v represents the valve covering the chamber C.

10. s represents the valve stem, or guide, of valve v.

11. g represents the centre of gravity of the lever arm a, valve v, and stem s.

12. p represents the steam pressure above that of atmosphere (as shown by the steam gauge).

13. A represents the area of the valve chamber C, and is the square of the diameter D, multiplied by the decimal 0.7854; or $0.7854 \times D^2$.

14. F represents the force p due to the weight W, multiplied by the long arm L added to the momentum $w\ x$, this latter being obtained simply by multiplying the weight w by the distance x, which is a constant quantity in the graduation of the lever for different pressures of steam.

From the above illustration it will be seen that there are three forces.

First. The weight W acting on the long lever L.

Second. The weight of the lever arm a, valve v, and stem or guide s', acting on lever x.

Third. The force due to the steam pressure p, per square inch, multiplied by the area A, of the valve v, in square inches, acting on the short lever l.

(To be Continued.)

AN APPRECIATIVE LETTER FROM THE FAR NORTHWEST.

GOVERNMENT TELEGRAPH SERVICE,
DEPARTMENT OF PUBLIC WORKS,
DOMINION OF CANADA,

EDMONTON, N. W. T., 19th May, 1891.

Editor ELECTRICAL NEWS.

DEAR SIR,—I have often wondered why we could not have a home journal devoted to electricity, and gladly welcome the NEWS. I hope you will soon issue it weekly, or at least semi-monthly. I enclose a year's subscription. Send me the numbers for Jan., Feb., and April; I have those for March and May.

Yours truly,

ALEX. TAYLOR.

CORRECTION.

TORONTO, June 16th, 1891.

Editor ELECTRICAL NEWS.

DEAR SIR,—Kindly make the following corrections of typographical errors in my answers in your Engineers' Competition: Question No. 2 instead of "71% saving" should read "7·1% saving," which makes considerable difference.

In No. 12 "highest variations of speed" should read "slightest variations of speed."

I am sorry you did not meet with more success in your effort to benefit engineers, and I should have considered more credit due the winners had there been many more competitors. May say I am quite satisfied with the decisions given by the judges.

Yours truly,

G. C. MOORING.

A CHEAP AND VALUABLE ASSISTANT.

NEW HAMBURG, June 1st, 1891.

Editor ELECTRICAL NEWS.

DEAR SIR,—Enclosed please find the sum of one dollar for ELECTRICAL NEWS to Jan. 1st, 1892. Your paper has been of good service to my electrician who has charge of my plant here, and has been useful to me on several occasions. Am sorry it could not be published every two weeks instead of once a month.

As representative of above firm, I take considerable interest in advocating the benefit derived by pursuing the columns of your journul. I think no mechanic in the country should be without it.

Wishing you unbounded success in your enterprise, I am,

Yours respectively,

CHAS. F. ERNST,
Prop. New Hamburg Electric Light Co.

ANOTHER BOILER EXPLOSION.

TORONTO, June 4th, 1891.

Editor ELECTRICAL NEWS.

DEAR SIR,—I am informed that a boiler explosion took place in Bailey's wood yard on Dufferin street, in this city, on June 1st. The damage resulting is said to be about $1,000. Fortunately no lives were lost, but of course this fact is to be attributed to good luck, as I presume there was no person near the rotten old scrap heap at the time.

The cause of this explosios no doubt was: 1st, A rotten old boiler, which was unable to hold the pressure it was subjected to; and, 2nd, An incompetent man placed in charge.

Will the city authorities take this matter up and investigate it? Not they! But if half a dozen people had been blown into eternity, they would have been compelled to do so. In that case, ten chances to one the so-called engineer would have been among the killed, and the men who made the investigation would have laid all the blame on him (of course because he was dead). They would never lay any blame on the owner of the boiler (death trap) for buying a second-hand, corroded old tank, and then placing it under the care of an incompetent man—probably a man who had never fired a boiler in his life before.

I say that the steam user who puts into operation an unsafe boiler and places an incompetent man in charge of same, and an accident follows in which lives or property is lost, should alone be held responsible.

However, after this month all stationary engineers will be able to obtain certificates of competency, under the new Act passed at the last session of the Local Legislature, and steam users will do well to see that their engineers obtain the necessary certificate to prove that they are not ignorant of the duties of the positions to which they aspire. And all steam users when engaging engineers will study their own interests by insisting that applicants must hold an engineer's certificate. They will, by so doing, have the satisfaction of knowing that they have a man in charge of their steam plants who is sober, steady, and has the necessary qualifications to prove himself a reliable and practical engineer.

Yours respectfully,

"SAFETY."

THE NEED OF QUALIFIED ENGINEERS.

TORONTO, June 22nd, 1891.

Editor ELECTRICAL NEWS.

DEAR SIR,—I hear that Mr. Hamilton, the "steam fitter," who was appointed to the position of chief engineer in the Canada Life building, has been discharged, and it was no more than I expected. No person could expect that a man who had served his apprenticeship at steam fitting (and had worked at his trade all his life) could turn out to be a competent engineer, without the necessary study and experience which is required to make a man a good engineer.

I feel that I am safe when I say that there is not one steam fitter in every one hundred who knows anything about the proper handling of a steam boiler, to say nothing of his being able to compute the safe working pressure, or whether the boilers are of sufficient strength and stayed in accordance with the rules of the Board of Trade (English), which rules all competent engineers are familiar with.

Yet in the face of all this, the officers of a concern like the Canada Life and several others in this city, will go to work and appoint a man to take charge of a battery of boilers and engines who has no knowledge whatever of the dangerous apparatus he is supposed to be master of. At the same time, much valuable property and (what is still more valuable) many human lives are at stake.

It is high time that the authorities at our City Hall took the matter in hand, as the citizens of Toronto have a right to demand that the men who are operating as engineers in the many large buildings and under sidewalks be compelled to prove that they have at least the necessary knowledge to enable them to operate the steam plants under their charge with perfect safety. It does not follow that in order to do this a man must be an expert mathematician or chemist, but he must be a practical engineer.

It is only a week or two since a man who calls himself chief engineer in an electric light station in this city, ran a boiler night and day for over two months, so that the boiler became so foul with mud and sediment that one of the sheets was bulged and blistered. At the same time he had five other boilers lying idle, and after washing this boiler out, he ordered the fireman to fire her up again, but the fireman (more power to him), refused to do so until the sheet was repaired. Yet this man holds a position as chief engineer, although he could'nt pass an examination as a good fireman.

Yours, &c.,

S.

THE H. P. OF ENGINES.

Editor ELECTRICAL NEWS.

DEAR SIR,—*Mirabile dictu!* No engineer that has written on the subject at least, has been able to see the point aimed at, or properly explain it, although some come near it. All see something different in it to what they have heard or seen. I will now try to explain.

I will try, as I have hitherto done, and avoid technical terms and formulas, as only few engineers have a technical education and will better understand my meaning if put before them in plain words. I am writing to the young engineer and those who wish to learn. There is a very erroneous idea prevalent, and among scientific men too, about h. p. I am now confining this term strictly to its original meaning. Some think that it makes no difference at what rate the horse travels whether he raises 33,000 lbs. 1 ft. high, or 1 lb. 33,000 ft. That sounds very well in theory, but this is where the error creeps in. This theory would be all right if the horse's power decreased as his speed increased, but such is not the case; as his speed increases his power decreases inversely as the square of the next number, according to Leslie and other experimenters. If a horse travelling at the rate of two miles per hour can carry 100 lbs.,

the same horse travelling three miles per hour can only carry 81 lbs., four miles per hour, 64 lbs., five miles per hour, 49 lbs., &c. Then there comes a time or rate when the horse can with great difficulty move his *own* weight *only*—not an ounce or fraction more. Then what becomes of the 33,000 lbs.?

Some will say that he is overcoming or moving against atmospheric resistance. True, but he is an expensive ornament only, which men concerned in matters of this kind would not keep up.

If the horse could keep up this high speed and go around the world, when he got around to the 33,000 lbs. again, he would not have moved or raised it the 1,000 part of an inch. This fact is but little understood by engineers, as any can tell who understands his business or gives the subject a thought.

Again, if a horse moves a carriage on a level road at the rate of 2½ miles per hour, and exerts × lbs., at 4 miles it would be 2 ×, &c.,

Mr. Galt was all right until he said it did not matter at what rate the horse was moving or travelling, and took the average horse ; then he struck a hidden snag.

A h. p. is a power that can raise 33,000 lbs. 1 ft. in one minute travelling at the rate of 220 ft. per minute, (see any of the authors quoted). *The reason that 33,000 lbs. is not multiplied by 220 in the text books is that 220 ft. per minute is the standard rate at which the horse is travelling.* Any one who has watched horses on a race course or have themselves run a foot race know this, or ought to know it.

Seeing is believing, but feeling is the naked truth, so is it with theory and practice. *Theory will not stand alone.* As a rule, there is too much theory and conservatism in our schools and colleges. Practice goes before theory every time. Theory is founded on practice.

C. W. Ross,
C. & M. E.

THE N. E. L. A. CONVENTION.

Meetings of the Executive and Exhibition Committees to consider the advisability of postponing until September the Electric Light Convention to be held in Montreal, were held in that city on the 8th and 9th of June.

The following gentlemen were present : C. R. Huntley, president of the Association ; F. R. Redpath, of the Redpath Refinery ; Profs. Bovey and Cox, of McGill University ; M. D. Barr, of the Edison Company in Toronto ; W. J. Morrison, Fort Wayne Electric Company ; Fred Nicholls, of Toronto Incandescent Electric Light Company ; H. H. Fairbanks, of Worcester (Mass.) Electric Light Company ; E. F. Peck, Citizens' Electric Illuminating Company of Brooklyn ; J. W. Beane, secretary and treasurer of the Association ; S. C. Stevenson, Council of Arts and Manufactures, Montreal ; A. J. Corriveau, Canadian Electrical Construction, Manufacturing and Supply Company ; and John Carroll, Eugene Phillips Electrical Works, Montreal.

The members of the above Committees were cordially welcomed by the Mayor and Ald. Stevenson on behalf of the City Council, and by ex-Mayor Beaugrand especially on behalf of the French-Canadian citizens.

Professors Bovey and Cox, of McGill University, and Mr. John Carroll, of the Phillips Electrical Works, representing the Reception Committee, read the following report :

Montreal, June 8, 1891.

The committee has held three meetings. A Reception Committee is being formed which already includes a large number of the most influential citizens of Montreal.

His Excellency, the Governor-General, has signified by letter that if the visit of the Association takes place in September, he hopes to be present, but under any circumstances will be glad to give his patronage to the meeting.

A number of plans for offering entertainment to the Association have been considered, but the final adoption must depend upon the date adopted for the visit, and the programme of the Association. Among the suggestions already considered by the committee are plans for a citizens' ball, a lacrosse match, an excursion to the Rapids, drives around the mountain, a promenade concert at Sohmer Park, visits to the G.T.R., C.P.R., and Dominion Bridge Works.

A Press Committee and Ladies' Committee will be formed, and special entertainment provided for the ladies of the association.

The officers of the Executive Committee, with Mr. John Carroll, were instructed to wait upon the executive of the association on June 8, and convey to them a cordial welcome to Montreal.

The report was enthusiastically received and adopted.

After due deliberation, it was decided that the Convention should open on the 7th of September, and that the Exhibition should remain open each day and evening from the 7th to the 16th inclusive, during which time the machinery will be in motion.

The powers and duties of the Exhibit Committee were defined, and the following local sub-committee appointed to co-operate with the chairman of the Executive in carrying forward the exhibition arrangements : F. R. Redpath, chairman ; Prof. Bovey, Prof. Cox, Fred. Nicholls, S. C. Stevenson, John Carroll and A. J. Corriveau.

The Executive Committee took into consideration the papers to be read at the Convention and a number of other important matters.

The outlook for a pleasant and profitable convention were never so bright. The demand for space at the Exhibition is so great that it is thought extra accommodation may have to be provided.

MONTREAL BRANCH NO. 1, C.A.S.E.

The meetings of this Branch during the month have been of unusual interest and were well attended.

On the 4th Thursday in May an interesting discourse on "Indicator Diagrams and the Method of Finding the M. E. P. by the Hyp. Log," was delivered by Mr. Thomas Norton.

The meeting held on the first Thursday in June was devoted to a discussion of "The Expansion of Steam," by several members.

At the second meeting, Messrs. Thompson and Nadin gave a number of rules for ascertaining the speed of pulleys, transmission of power by belts, also for bracing boiler heads.

Mr. H. Nuttall, at the third meeting told in his own amusing way of his experience with a gas engine, one of which he described as a Turkish bath of four hours duration. Mr. Thompson at this meeting worked out on the blackboard several safety valve problems. In this connection it should be remarked that the blackboard is an excellent institution which has come to stay.

At the fourth meeting Mr. John Oades gave a short lecture on "The Errors of the Lever Safety Valves," illustrating his subject by means of drawings. He did not conclude his remarks, it being his wish that the members should give the subject further thought and come prepared to renew discussion upon it at a future meeting.

Four applications for membership were received during the month.

The members of the Montreal Branch extend to those of the western branches their best wishes for an enjoyable time at their picnic.

TRADE NOTES.

The Royal Electric Company have installed a motor plant in the large wholesale warehouse of E. A. Small & Co., as well as a large number of fan outfits.

The Royal Electric Company are making an addition of a 150 light dynamo and the necessary lamps, etc., to the plant already installed in the Hotel DeLotinbiere at Vaudreuil.

The Royal Electric Company are building two 1500 light alternating dynamos for their lighting station in Montreal, and are busy preparing plans, etc., for a 3,000 light dynamo.

Messrs. Robin & Sadler, of Montreal and Toronto, have lately manufactured and put in operation in one of the Royal Electric Company's stations in Montreal, a 3-ply leather belt about 100 feet long, 38 inches wide.

A company has recently been formed to purchase and put in operation the rubber factory at Port Dalhousie, Ont., which has lain idle for a number of years. The promoters of the company, which has a capital of $200,000, are: Capt. S. Neelon, of St. Catharines, and Messrs. T. McIlroy, J. McPherson, Taylor, M. Matheson and Pearson, of Toronto. It is stated that the works will go into operation at once. The development of electrical industries has largely increased the demand for rubber goods.

PUBLICATIONS.

We have received from the Dodge Wood Split pulley Co., of Toronto, a copy of their new catalogue for 1891, numbering 36 pages.

The June *Arena* which opens the fourth volume of this able review is unusually attractive. A fine picture of Bishop-elect Brooks, printed on cardboard paper suitable for framing, is given as a supplement with this number. The frontispiece is a steel engraving of the editor, who contributes a paper of great interest on "Society's Exiles," dealing chiefly with life in the slums of Boston. The interest in this paper is enhanced by the admirable reproduction of ten flashlight photographs taken in the North End of Boston expressly for this contribution. These pictures, toge her with a full-page engraving of the artisans' apartment house, recently erected in Liverpool, are printed on heavy plate paper.

CANADIAN ELECTRICAL NEWS AND STEAM ENGINEERING JOURNAL

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ADVERTISEMENTS.

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SUBSCRIPTIONS.

The ELECTRICAL NEWS will be mailed to subscribers in the Dominion, or the United States, post free, for $1.00 per annum, 50 cents for six months. The price of subscription may be remitted by currency, in registered letter, or by postal order payable to C. H. Mortimer. Please do not send cheques on local banks unless 25 cents is added for cost of discount. Money sent in unregistered letters must be at senders' risk. Subscriptions from foreign countries embraced in the General Postal Union, $1.50 per annum. Subscriptions are payable in advance. The paper will be discontinued at expiration of term paid for if so stipulated by the subscriber, but where no such understanding exists, will be continued until instructions to discontinue are received and all arrearages paid.

Subscribers may have the mailing address changed as often as desired. *When ordering change, always give the old as well as the new address.*

The Publisher should be notified of the failure of subscribers to receive their papers promptly and regularly.

EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

OUR CONVENTION NUMBER.

IN consequence of the postponement by the Executive Committee of the date of the National Electric Light Association Convention in Montreal from August to September, the special Convention Number of the ELECTRICAL NEWS announced to be published in August will not be issued until about September 1st.

From the interest already manifested, and the amount of advertising space contracted for, there is no reason to doubt that a satisfactory measure of success will reward the effort of the ELECTRICAL NEWS to fittingly mark this important occasion.

AS we go to press arrangements are being completed for the picnic at Oakville under the auspices of the Canadian Association of Stationary Engineers. The affair is certain to be a success. An interesting series of athletic contests has been arranged, and prizes to the value of $300 are awaiting the winners. A report of the proceedings will be printed in the ELECTRICAL NEWS for August.

WHAT is the matter with our electrical men? There are the managers of two of the principal companies in Toronto who are the owners of steam pleasure craft. The question has been asked why it is that they still stick to steam with all its disadvantages, instead of using electricity as a motive power, when they are supposed to know all about electricity and what it is able to do that way. The best answer we can give is, that perhaps that is the principal reason. "The bearings of this here observation," as Bunsby would say, "lies in the application on it."

IT is interesting to know, in view of the probability of electricity being shortly used on our streets, that a recent decision of a United States Court of Appeal reverses a decision of a lower court in favor of a telephone company. The telephone company, as usual, claimed the earth by right of prior occupation and the court sustained them, but on appeal the decision was reversed on the ground that the streets were intended primarily for public travel and facilities therefor, and not for the convenience of subscribers to the telephone exchange. There is no doubt that the single trolley system of street railway, with ground return, is a source of serious annoyance to the telephone user in proximity to the route. The remedy, however, is in the hands of the telephone companies, and it is gratifying to the users of these instruments to know that the companies are awaking to the fact, and are more willing to apply the remedy of a metallic circuit inasmuch as it will eliminate a multitude of other troubles incident to the telephone as well as those caused by the proximity of the electric railroad.

CITIZENS of Toronto may be congratulated on the outcome of the negotiations of the Council with the telephone company. The demagogues of the Council aforesaid used their utmost endeavors to have an unconditional franchise granted to an opposition company, but it is fortunate that the older and wiser heads were able to command a sufficient majority to defeat the destructive scheme. The offer of the Bell Telephone Company to pay into the City Treasurer four per cent. of their gross receipts, to materially enlarge the scope of their underground operations, to supply telephone facilities to private residences at a reduced rate, as well as offering facilities in their conduits for city wires, was an eminently fair and business-like one. It would have been a great pity to have lost all these advantages, besides burdening the business man with a double telephone service and having the streets crowded with another set of poles and wires, but that is a consummation the citizens of Toronto have only missed by a very narrow chance, thanks to the peculiar constitution of some of the gods that the people have chosen to rule over them.

THE long distance transmission of electric power shortly to be tried between Lauffen and Frankfort, is provoking much adverse criticism among experts in Europe. We mentioned in our last issue, in connection with the Niagara Falls power scheme, the small likelihood of its being a commercial success, and we still think—while not being quite so pessimistic as the experts aforesaid—that the experimenters will meet with developments that they may not be quite prepared for. The power in the primary circuit is to be about 186,000 watts, say 30,000 volts and 6.2 amperes. There will be 3500 poles and 7000 insulators. At a low pressure, allowing a resistance to each insulator of 1000 megohms, the loss would not be more than 3.2 per cent. But at the pressure of 30,000 volts the leakage in fine weather may be as much as 15 watts, or 100,000 watts altogether on the Frankfort line, without taking into account possible fog and rain. But this is not all. There will be some loss between the conductors themselves. It is a large contract, that of carrying 300 horse power at a pressure of 30,000 volts over a distance of 100 miles, and the result will be looked forward to with interest.

THE indulgence of our readers is asked while with becoming modesty the statement is made that one hundred and fifty persons have become subscribers to the ELECTRICAL NEWS since the publication of the June number. This record was exceeded by at least twenty-five per cent. in May, and bids fair to be equalled by the present month. Letters are frequently received expressive of the satisfaction with which the NEWS is received by subscribers. This fact gives cause for gratification to the publisher, and should be no less satisfactory to every reader and advertiser. It is pleasing to observe the growing desire on the part of subscribers to make requests through these pages for information required by them in the discharge of their daily duties. This is precisely what we desire to see. Every reader who has an opinion to express or a question to ask pertaining to the subjects of electricity or engineering, is earnestly and cordially invited to make use of the columns of this journal for that purpose. The free exchange of opinions will render the paper increasingly valuable to every reader, and assist to a surprising degree the diffusion of technical knowledge.

THE argument on final hearing in the patent case of the Edison Electric Light Company vs. the United States Electric Lighting Company is now being made in the Circuit Court of New York. It goes without saying that this is the most important case to the electric lighting industry on the other side of the line that has occupied the attention of the courts for some time. The claims made by Edison cover broadly the manufacture of the incandescent lamp, and if allowed will give that company an immense advantage over their competitors. The business has grown to enormous proportions in the hands of rival companies,

greater, in fact, than in those of the claimant company itself. An adverse opinion, therefore, would carry with it an enormous amount of responsibility for damages. In Canada, however, it is a matter of very little moment, comparatively, as under the peculiar patent laws of this country the owners of a patented article are compelled to sell to all comers at what is termed in the statue "a reasonable price." A reasonable price, of course, would be held to be a price at which the article in question could be imported at or manufactured for sale at a profit by parties other than the patentee. There being no other lamps manufactured in Canada at present except by the Edison concern, and as the protective tariff gives that concern an ample profit, it is as much to their interest to sell as it is the consumers' to buy from the patentee, and thus avoid any responsibility for infringement. Without expressing any opinion as to the validity of the patents in question, it is safe to say that what the rival companies in the United States consider their rights will not be surrendered without a long and bitter struggle.

THE death of Sir. John Macdonald while marking perhaps the most important epoch in the history of Canada, seems not likely to result in a present disturbance of affairs political or commercial. Inasmuch as in the minds of many persons a national upheaval was believed to be the inevitable result of the event which all deplore, there naturally exists a feeling of anxiety regarding our national future. It is yet too soon, of course, to be able to form a well-founded opinion on the subject. Certain it is, that the removal of Sir John Macdonald from the position he so long occupied at the head of affairs, will be an important influence in hastening the solution of the problem. It is not generally believed that the Dominion will continue to occupy its present position for any lengthened period. If there exists any widespread feeling in favor of separation from Great Britain, it may now be expected to become manifest. If no such feeling obtains, we may expect to see a movement in the direction of closer commercial relations between the Dominion and the mother country. Meanwhile, all who have at heart the prosperity of our commercial and industrial interests must rejoice to observe the patriotic spirit in which the colleagues of the late Prime Minister have assumed the great responsibilities which he was forced to lay down, touching the nation's development and welfare. Canada has already attained to a position of no small importance, and the death of the one to whose efforts her past progress is so largely due, should serve as an incentive to those who shall hereafter be entrusted with the shaping of her legislation and consequent destiny.

THE inability of the average municipal corporation to successfully conduct a business enterprise, is receiving one more exemplification in the case of the Toronto Street Railroad. Though it has been a little over a month in the hands of the city, the receipts have shown a falling off of over a thousand dollars by the time they have reached the city treasury as compared with the same period last year, the expenses have increased fifty per cent., the cars are dirty and uncomfortable, and the state of the roadbed is simply villainous. Unless the railroad is speedily handed over to a private corporation the chances are that in a short time there will be no railroad to hand over. There have been handsome offers by a syndicate of citizens to take the property and pay the amount of the arbitrators' award and a handsome sum per year for the franchise, with an undertaking to make the change from horses to electricity within two years. Why this offer is not accepted is a mystery. Its acceptance would mean the expenditure of two millions of private funds in the work of construction. One of the largest steam and electric plants in existence would be at once installed, and a rapid and comfortable service given to the citizens. The success of the electric method of propulsion is now demonstrated beyond question, and the citizens should no longer be deprived of its advantages. The overhead method of construction would have to be employed, as nothing successful has as yet been evolved in the way of a conduit, but while properly constructed, it need not be considered a permanency, as it could be changed in the future if the development of the art ever permits of its being done. Let the Mayor and Council respect the pledge they gave the people when the funds to purchase were provided, that the city would in no case attempt to run the road, and hand it over to the company who will pay the most for the privilege, with the undertaking to provide electrical rapid transit at the earliest possible moment.

ONE of the most difficult problems that confronts the electrical engineer is to decide which of the many methods or systems in vogue may be most profitably employed in the particular location he has chosen as his field of operations. If it is an incandescent system of lighting that he is exploiting, and his source of power is at some little distance from the point of consumption, the question has to be decided between a direct and an alternating current with transformers. Of course we would all prefer the low tension direct current system, provided that the cost of copper for conductors does not make it prohibitive. If a system of this kind is considered to be feasible, the engineer has then to strike a balance as it were between the interest on cost of his copper conductors and the required size of his coal pile. By enlarging the wire there is less loss in transmission, but on the other hand, it may be made so large that the interest on cost of construction would be more than the extra cost of coal required to drive the current through smaller mains. Then, if a straight incandescent system is impracticable by reason of distance, a choice must be made between a series or an alternating current system with converters. Both involve higher tension on the wires, but this is becoming every day a matter of smaller moment, as improved insulation is a large factor both as regards safety and immunity from loss of current through leakage. If a power distributing circuit is contemplated, the problem is even more intricate. To get any distance from the generating station, a considerable voltage must be employed, and this precludes the use of very small motors, it being almost impracticable to build a motor as small as one-eighth horse power to work a 500 volt constant potential circuit. The constant potential method of distribution is the most suitable for motors, though in case of greater distances a series system may be employed. The motor on a series current is not self-regulating as on a constant potential, and requires special regulating devices. Throughout the whole range of the electrician's duties, this problem of doing the right thing at the right time and in the right place is the most important one, and the failure of many a promising venture in the electrical field has been brought about by the inexperienced manipulator endeavoring to fit a square peg into the inevitable round hole.

THE MONEY VALUE OF HEAT.

THE *Journal of Industry* discusses the money value of heat, which it argues will in the future become a standard of value perhaps more stable than gold or silver just now. The gist of its investigation just now is: In its primary form of fuel representing power, light and a resolvent in the various industrial processes in which it is an agent, heat is now one of the most important commodities we have to deal with. Without fire and power we would be in barbarism, or some other undesirable state.

It is not very long since heat and its relations were a mystery. If we call it fifty years since it became a recognized element in all natural forces, it is easy to see how rapidly it is working its way to becoming a "commodity" that we will have to measure and price the same as wheat, cotton, or iron. At this time there is a singular variation in its price, due to various means of its generation and application. In coal, wood and petroleum, example, when used as fuel their measure of value should be the heat contained and the relative expense of converting this heat into useful form. That this will be the end no one can doubt, but the claims of economy for various different kinds of engines, and systems of lighting and warming show that the price of heat is far from fixed at this time.

In science, or even in the treatment of steam and gas engines, units of heat have become a tangible and convertible quality, having a constant symbol of $T-t$ or total heat units, less units lost, and it will not take long to find a common price for this indispensable commodity.

The Montreal Metal Works (Limited), Montreal, will be incorporated with a capital stock of $50,000, to manufacture and deal in wires, rods, cables, and every description of apparatus and metals used in connection with the business of telephone, telegraph, electric light, electric railroad or cable companies.

QUESTIONS AND ANSWERS.

T. W. asks: What is the derivation of the words "ohm," "watt," "volt," "ampére," etc., used by electricians as their units?

ANS.—They are mostly derived from the names of men distinguished in their special fields of study. The unit of capacity is one farad; of resistance, one ohm; of work, one joule; of activity, one watt; of quantity, one coulomb; of current, one ampére; of magnetic field, one gauss; of pressure, one volt; and of force, one dyne, and are from the names of Michael Faraday, George S. Ohm, James P. Joule, James Watt, André M. Ampére, Chas. A. Coulomb, Carl Gauss and Volta, the Italian discoverer. The "dyne" is derived from the root word of dynamo, itself meaning force.

JOHN M. MORRIS, Hamilton, writes: I wish to know the required weight of a receiver containing stored electricity to the amount of one horse power for one hour.

ANS.—The weight of storage battery required to return the amount of power you name would be between 225 and 240 lbs. This would be sufficient weight to allow of the battery being about half discharged. It is not advisable to entirely discharge a storage battery at each time of using.

"SUBSCRIBER," Listowel, Ont., writes: Will you kindly answer the following questions in the next issue of your valuable paper: Is a compound engine, one in which the steam is exhausted from one cylinder into the other, more economical than a single cylinder engine whose cylinder is of as great capacity as the two cylinders? If so, please state the reasons why.

ANS.—It is generally conceded that a compound engine is more economical than a single cylinder, more especially when a condenser is used. Among the reasons assigned for this are the following: (1) It is possible to get a greater ratio of expansion with two cylinders than can be got with one; (2) The loss from internal condensation is very much less with the compound. Using an automatic cut-off engine with everything about her in good order (that is, no leaky valves or pistons), an indicated diagram taken with 65 lbs. steam initial pressure, and cut-off at 20% of the stroke, should give a result of about 28 lbs. of water per h. p. per hour. The water consumption in a compound engine, figured from the indicated cards in the same way, would give us at 20% cut-off, and same initial pressure, about 15 lbs. water per h. p. per hour.

USEFUL NUMBERS FOR ASCERTAINING THE AVERAGE PRESSURE OF STEAM IN AN ENGINE CYLINDER WITH ANY CUT-OFF.

BY WM. COX.

In a former number (Jan. 3, 1891) we gave a number of equivalents or useful numbers for purposes of calculation and for slide-rule practice. In the present article we give a similar series for computing the average pressure of steam in lbs. per sq. inch for the whole stroke of a piston, when the initial pressure and the portion of the stroke at which the steam is cut off are known. They are based upon the formula:

$$p = P\,\frac{1+H}{R}$$

in which p = initial pressure in lbs. per sq. inch, including atmosphere.

R = ratio of expansion.

H = hyperbolic logarithm of R,

and p = mean pressure during stroke in lbs. per sq. inch, including atmosphere.

No allowance is made for imperfect vacuum. If, for instance, the steam is cut off at half stroke, we have from the table initial gage point 13, and average gage point 11, and for ordinary calculations we multiply the initial pressure by the average G. P. and divide the product by the initial G. P.; the quotient is the average pressure for the whole stroke, or

$$\text{Average pressure} = \frac{\text{initial pressure} \times \text{A. G. P.}}{\text{I. G. P.}}$$

For slide-rule practice, for which these gage points are specially suitable, as they all fall upon *marked* divisions of the rule and slide, and require, therefore, no estimation of the intervals of the one or the other, we place the initial G. P. for the given cut-off on scale C of the slide, so that it coincides with the average G. P. on scale D of the rule. We then have on the slide a series of initial pressures, and coinciding with the same, a series of average pressures on the rule, all corresponding with the given cut off. The diagrammatical demonstration is as follows:

C	Set initial G. P. for given cut-off	Under initial pressure.
D	To aver. G. P. for given cut-off	Find average pressure.

Example: Given an initial pressure of 75 lbs. per sq. inch, with the steam cut off at three-quarters of the stroke, what is the average pressure for the whole stroke?

$$\text{Average pressure} = \frac{75 \times 53}{55} = 72.27 \text{ lbs.}$$

On the slide rule,

C	Set 55	Under 75 lbs.
D	To 53	Find 72.27 lbs. average pressure.

Portion of stroke at which steam is cut off.		Initial G. P.	Average G. P.
	⅞	250	248
	¾	55	53
	⅝	37	34
	½	13	11
	⅜	31	23
	¼	57	34
	⅛	65	25
9-10	—	200	199
8-10	—	139	136
7-10	—	139	132
6-10	—	167	151
4-10	—	214	164
3-10	—	30	152
2-10	—	46	24
1-10	—	100	33
5-6	—	68	67
4-6	—	80	75
2-6	—	10	7
1-6	—	43	20

NOTE.—These gage points are intended for the Manuheim slide rule, scale C on the slide and scale D on the rule, being both graduated alike.—*Engineering News.*

NOTES.

The Montreal boiler shops are said to be filled with orders at present.

A boiler in use in Daniel Reichert's brickyard at St. Clement's, Ont., exploded a few days ago, seriously injuring the son of the proprietor and killing instantly a sixteen year old lad named Mickens.

Line shafting should never be placed along the side of a room so that all the machinery will be belted from one side. Equalize the strain on the shaft by putting the machines on both sides. For this reason the shaft should be run through the center of the room.

The experimental section of the Magdeburg society of boiler users communicates the fact that ordinary cement made into a stiff paste with water (so that it adheres to a vertical wall) is admirably adapted for closing the manholes of boilers, and holds the two surfaces well together. The cement becomes sufficiently hard in 8-12 hours, and can then be submitted to pressure.

At a meeting of Toronto Branch No. 1, Canadian Association of Stationary Engineers, held on June 26th, the following officers were elected for the ensuing year: President, A. E. Edkins; Vice-President, W. Lewis; Recording Secretary, W. G. Blackgrove; Financial Secretary, E. Phillip; Treasurer, W. Sutton; Con., W. Butler; Door Keeper, C. Mosely; Trustees, A. E. Edkins. W. Sutton, S. Thomson.

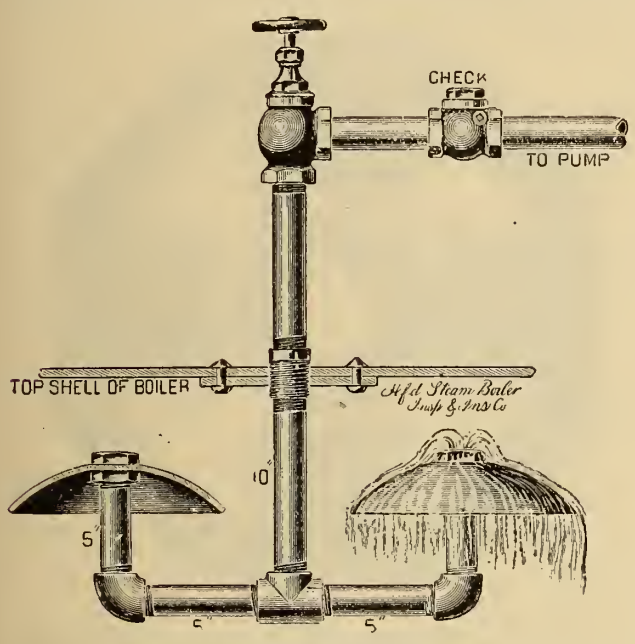
Boiler users who desire simple tests for the water they are using, will find the following compilation of tests both useful and valuable: To test for hard or soft water, dissolve a small piece of soap in alcohol, and let a few drops of the solution fall into a glass of the water. If it turns milky, it is hard water; if it remains clear, it is soft water. To test for earthy matters or alkali, take litmus paper dipped in vinegar, and if, on immersion, the paper returns to its shade, the water does not contain earthy matter or alkali. If a few drops of syrup be added to a water containing an earthy matter, it will turn green.

Notwithstanding the many years the steamboiler has been under observation, there are conditions of steam making which play strange tricks, as indicated by the steam guage, the pressure, without any discoverable cause, at times increasing 40 to 50 degrees in as many seconds, and not infrequently leading to disaster. In a big electric light station in Philadelphia there has recently occurred a series of mishaps to the boilers extending over a period of 12 or 14 months, the strongest bolts being inadequate to keep the bends and headers intact. Experts have examined and studied, but without being able to agree upon the cause, and though a coroner's jury, made up of boilermakers and engineers, called to inquire into the cause of an explosion which killed one man and frightfully scalded two others, brought in a verdict against the electric company, it was unable to explain wherein there had been want of precaution, or point out the safeguards required to prevent a similar occurrence.—*Scientific American.*

TOP FEED IN BOILERS.

PROBABLY few engineers or owners of steam boilers appreciate the effect that the introduction of feed-water has upon a boiler, so far as its life is concerned, says a writer in the *Locomotive*. If it could be introduced at a steady stream, and at a uniform temperature all the time the boiler is in operation, the location of the point of introduction would be of little importance, particularly if the water was free from scale-forming substances. Such favorable conditions, however, are rarely met with. Most boilers are fed intermittently, the feed varying in temperature between say, 60 degrees and 200 degrees. In every case its temperature is lower than that of the boiler, and if care is not taken it will chill the shell and start leaks or cracks, if it does nothing worse. Then, too, the deposit of scale cannot be considered to any great extent. The present article is designed to show how all expansion and contraction of shell-plates may be avoided, and deposit of scale largely prevented. These can be accomplished, in the writer's experience, by spraying the feed into the steam space of the boiler. Experience has shown that this can be done without noticeably increasing the moisture in the steam passing over to the engine.

A simple device for accomplishing this is shown in the accompanying cut. It is made of pipe of the same size as the feed line. The spray plates are 10 inches in diameter, made of iron (16 gauge being a good thickness), and hammered into convex



TOP FEED APPARATUS.

shape. The short upright pipes shown in the cut pass through them, and to these the plates are secured by lock nuts above and below. The water bubbles up to the top of the plates, and runs off as it would from an umbrella. The trap form of the arrangement prevents steam from entering the feed line and causing snapping or pounding noises from condensation. There are two free openings, each of which is the full size of the main feed pipe.

By spraying it into the steam space in this way, the water becomes thoroughly heated before mingling with that in the boiler below, and, as it is in small particles, it is carried along in the general circulation, and does not come in contact with the shell in such a way as to cause contraction. Furthermore, the scale-forming material is precipitated in a finely purvulent form *in the water*, and not on the tubes or plates, so that instead of adhering to the boiler it remains in suspension, and is readily gotten rid of when the boiler is emptied for cleaning. My experience shows that boilers can often be kept clean by this method of feeding, when the scale was very troublesome with the ordinary arrangement.

When the water is very bad some scale will be deposited, though the amount will be much less than with any other method of feeding, and the location of the deposit can be pretty well controlled. It will form close to the feed pipe discharge.

We have next to consider the best place to put the delivery. No absolute rule can be given for this, but, generally speaking, it should be as near the front head as practicable, in tubular boilers ; for the deposit, if it forms, will then be least likely to injure the tubes or cause leakage. In long flue and plain cylinder boilers the rear end is preferable, for in these types the shell is most likely to receive the deposit, and the rear end is the coolest portion of the shell. In any case the spray feed should be as far from the main steam opening as possible, in order that the strong current of steam passing out may not catch the particles of water and carry them over into the engine.

In some sections of the country the top feed is used very generally, and in all cases it gives satisfactory results when properly set in.

MINING BY ELECTRICITY.

The *Free Press*, published at Nanaimo, B. C., tells as follows of how coal mining is done at the Union mines, Vancouver Island, by electricity :—

A *Free Press* representative called on A. Dick, Government Inspector of coal mines, on his return yesterday from an official visit to the Union Colliery at Comox. Mr. Dick then gave a description of the electric machine—the first of the kind he had seen—as wonderful and doing its work with the utmost ease and the precision of clockwork. He timed the machine while at work and found that it "mined" 6 feet by 39 inches, and four inches deep, in five minutes. It also took five minutes from the time of finishing cut until it commenced work on the next. To move it from one stall to another takes about half an hour. Mr Dick expressed the opinion that it will greatly facilitate the mining of coal, and also that the coal will come out in a more merchantable condition. In fact Mr. Little, manager, and Mr. Russell, overman, said the refuse from the machine was not half that by the ordinary mode of mining.

D. N. Osyer, electrician of the Jeffrey Electric Company, of Columbus, Ohio, is at present at Union placing the machinery in order, and instructing the operators. Mr. John Ead is in charge of the cutting machine, having one helper, who, with an engineer in charge of the dynamo, is the entire working force. The steam is supplied from the colliery boilers.

Mr. Osyer expects to remain at Union about two weeks longer, and says that in the long stall system of coal mining the machines can do a much greater percentage of work than in the small stall system. The machine simply does the undermining, then the miner comes along, drills the holes, fires the shots, and loads away the coal.

Following is a brief technical description of the machine as given by the manufacturer :

The machine consists of a bed frame occupying a space two feet, by eight feet six inches long, composed of two steel channel bars firmly braced, the top plates on each forming racks with their teeth downward, into which the feed wheels of the sliding frame engage. Mounted upon and engaging with this bed frame, is a sliding frame similarly braced, consisting mainly of two steel bars, upon which are mounted, at the rear ends, the electric motor, from which power is transmitted through straight gear and worm wheel to the rack, by means of which the sliding frame is fed forward. Upon the front end of this sliding frame is mounted the outer bar, held firmly by two solid steel shoes, with suitable brass boxes. The cutter-bar contains bits, made of tool steel, held in place by set screws. When the cutter-bar is revolved by an endless curved link steel chain from the driving shaft, and as it is revolved, is advanced by the above mechanism into the coal or other material to be undercut to the desired depth.

The electric motor occupies a space of about twenty inches square. The current required is 50 amperes at a pressure of 220 volts ; the motor is wound to develop 15 h.p., though frequently in some veins of coal the machine only uses 30 amperes or 7½ h. p. in making cuts. The machine is started by means of a switch located on a suitable resistance box, on the rear end of the motor, the same being arranged with buttons ; the current is gradually turned on by simply passing the lever over these buttons. The armature of the motor is calculated to run at a speed of 1,000 revolutions per minute, from which the speed is reduced so as to run the cutter-bar 200 revolutions per minute. The momentum of the armature is such, that ordinary obstructions met by the cutter-bar in the coal are not perceptible, causing the machine to run steadily and comparatively quiet.

Mr. Harry Eckhardt, manager of the Bell Telephone Co.'s Brantford agency, was married a few days ago to Miss Mary Campbell.

NOTES ON THE DESIGN OF MULTIPOLAR DYNAMOS.*

THOUGH comparisons have frequently been made of the capabilities of machines having two poles and those having a greater number, I am not aware that the design of the multipolar dynamos has yet received systematic treatment in any communication, or that a very satisfactory basis for comparison of the two types has up to the present been suggested. A perusal of the notes scattered about in technical journals, proceedings of societies, and text-books shows that the ideas on this subject are of the vaguest character, their expression having a most uncertain tone, and generally manifesting some erroneous notion. It is with the view of clearing the ground a little, and inducing some expression of correct ideas from members present, that these notes are brought before the Institution.

1.—PREVENTION OF SPARKING IN MACHINES GENERALLY.

In the paper which I submitted for your consideration twelve months ago, attention was directed to certain empirical formulæ relating to the armature loads for direct current machines. From the data furnished by a large number of examples, some of which were given in the paper, an expression for the load which could be safely carried by armatures without causing sparking was obtained; this expression, though admittedly of an arbitrary character, having been proved by my own experience, and that of my colleagues, to have been of some service. In that paper the term "ampere turns" was employed to denote the product of the number of conductors on the exterior of the armature and the current carried by each, and I am afraid this may have led to some confusion; at least, so it appears from the discussion. In order that there shall be no misunderstanding in the present case, I shall call this product, quite irrespectively of the number of poles, the *volume* of current carried. The volume is therefore the total current flowing parallel to the armature shaft, independently of direction and whatever the number of poles, and it is obtained by multiplying the conductors on the exterior of the armature by the current flowing in each; or, considering the exterior winding as a copper cylinder, it is the total current flowing in it parallel to the axis.

In his paper on "Armature Reactions," read here last year, Mr. Swinburne had worked out the limiting load from a theoretical point of view, and those who were present will remember that to obtain the results given in his paper the author assumed that the brushes were placed almost close to the polar tips. So far as the practical consideration of the subject goes, it matters little, I think, whether this is strictly accurate or not, because, while moving the brushes back from the tips increases the ampere turns producing the cross field, the magnetic resistance of the cross circuit is at the same time increased, due to the interposition of an increased air gap. For the moment, however, it will be assumed that the brushes are somewhere near the pole tips—in their vicinity, let us say—and that the only conductors concerned in producing the cross field are those covered by the pole pieces. This is sufficiently near the truth for our purpose. Under these circumstances the magnetizing force in ampere turns producing a cross field is, of course, $\frac{v\ \phi}{360}$, where v is the volume and ϕ the angle embraced by each pole piece in degrees. Call l the length of the air gap, measured from the surface of the armature core to the polar surface, and I the induction per square centimetre which would be produced in the gap due to field magnets alone. When a current flows in the armature, the field is weakened at the pole tips nearer the brushes, and strengthened at those farther from them. Imagine that the armature is loaded so that the forward induction under the nearer pole tips is just balanced by the cross induction, and we have $\frac{v'\ \phi}{360} = 2\ l \times .8\ \mathrm{I}$, assuming that the components of the cross circuit, other than the air gap, have no resistance. According to this equation with a value $v = \frac{576\ l\mathrm{I}}{\phi}$,* the forward and cross induction at the pole tips would be equal, the field would be *nil* at the brushes, and the machine being unstable, any increase of current would at once cause great sparking.

The above expression gives what might be called the theoretical load limit, on the assumption that no field is required for reversing the current in the sections as they pass the brushes, but it need scarcely be pointed out that in practice the volume is always much under what would be given by the formula. In the nature of things, one expects in the dynamos of different makers a considerable variation in the relation which the actual load bears to the limit above indicated, and such differences undoubtedly exist; but while one finds, on examining a large number of machines, several under, in few cases are there any having for v a greater value than half that given by the equation. This large margin must be considered in the light of a safety factor, for it would be folly to build machines the commutators of which would be liable to ruin by an occasional increase of current over the normal. No one expects machines to stand in continuous working a current of 50 per cent. over their normal output, for the rise in temperature would then be excessive; but, from the sparking point of view, this increase in a well-designed machine ought to make but little difference to it. Generally, the relation existing between the volume, gap dimensions, and induction in the best machines is expressed approximately by the equation,

$$v = \frac{288\ l\ \mathrm{I}}{\phi} \qquad (1)$$

which gives, I consider, a very good rule for use in practical work. According to this, the working volume has about half the value expressing the absolute limit, this relation indicating

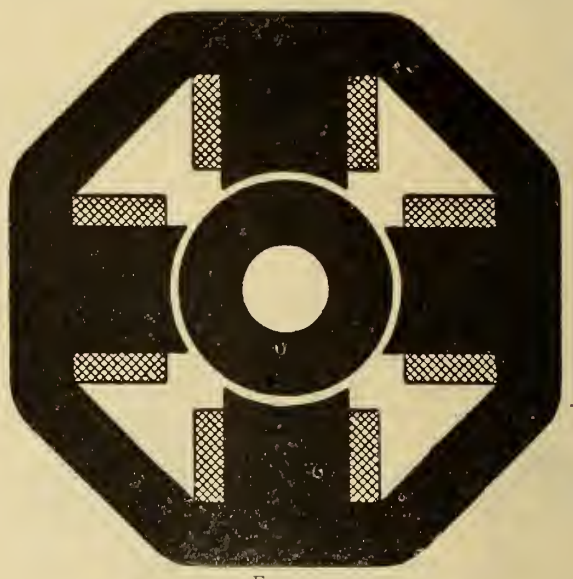


FIG. 1.

the margin of safe working dictated by practice and experience. The formula expresses, in fact, an empirical relation which has a certain degree of flexibility. But with such a large margin it will be readily perceived that the strict accuracy of our assumption about the position of the brushes is of trifling importance, as is also our assuming that the whole of the magnetizing force of the cross-field is spent in the air gap.

It is easy to translate the above expression into the form I previously used for cylinder armatures. Call r the radial depth of the armature core, w the width of the pole piece and I_2 the induction in the core. The induction, I, in the gap is $\frac{2\ r\ \mathrm{I}_2}{w}$; and substituting for I its value, we have

$$v = \frac{576\ r\ \mathrm{I}_2^2\ l}{w\ \phi}. \qquad (2)$$

Taking the induction in the armature core at from 17,000 to 18,000 C. G. S., per square centimetre, and inserting an average value of Φ we get for bi-polar Gramme-wound machines the expression

$$v = \frac{r\ l\ 85{,}000}{w} \qquad (3)$$

* Paper read by W. B. Esson before the Institute of Electrical Engineers, London, April 9, 1891.

* I have pointed out to Mr. Swinburne that the equations $\mathrm{A} = \frac{10\ b\ g\ \mathrm{B}a}{\Theta^2\ r}$ and $\mathrm{A}_2 = \frac{10\ \mathrm{B}a\ r\ \mathrm{R}\ l}{w^2}$ which he gave last year on p. 266 of his reply, ought to be $\mathrm{A} = \frac{5\ b\ g\ \mathrm{B}a}{\Theta^2\ r}$ and $\mathrm{A}_2 = \frac{20\ \mathrm{B}a\ r\ \mathrm{R}\ l}{w_2}$ respectively. In looking over his paper and reply Mr. Swinburne finds other slips which he will probably correct as discussion on the present paper proceeds.—W. B. E.

which I had used for some time, and which was given in my last year's paper. This is only a rough approximation, for, as Mr. Swinburne has pointed out, to be quite accurate, the angle should appear in the denominator as in 1 and 2. The simplest form the expression can take is given in 1. This contains nothing but the length of the air gap, the induction in it, and the angle of the pole-piece. It will be observed that it takes no notice of the diameter of the armature or of the number of poles. So far as the sparking limit is concerned, it gives a rule which may be employed in designing machines of any size and with any number of poles.

2.—THE RELATION OF v TO THE DIAMETER OF THE ARMATURE.

But besides taking care that the armature load does not approach the sparking limit, we must provide ample surface for getting rid of the heat generated in the conductors. The first thing to be settled in designing a new machine is what the amount of heat shall be ; or in other words, we must fix the ratio which the energy appearing at the terminals shall bear to the total electrical energy produced. Having settled this, sufficient radiating surface must be allowed to prevent too great a rise in temperature—a point to which due consideration has already been given.

The principal factors which determine the relation of the volume to the diameter of the armature are efficiency and temperature. It will be seen that the equation (1) gives no direct information respecting the diameter for a given volume, and as long as 1, l, and Φ remain unchanged, the tendency to sparking would be the same whatever the diameter. But it is not so with the heat generated or the temperature rise, for assuming v and l to be related as shown, the smaller the diameter, the greater would be the temperature. To carry a given volume we must have, consistent with the waste of power permissible, a certain section of copper ; and this copper should be disposed so that a cooling surface is provided sufficient to keep the rise in temperature within the specified limit, while the gap, being of sufficient length to prevent sparking, should have only the dimensions necessary for accommodating the conductors and allowing of proper clearance.

Through the kindness of members of the Institution and others, who have liberally supplied me with figures, I have been able to ascertain the nature of the relation between the diameter and volume existing in all the best known machines, from the smallest to the largest sizes. The figures refer to both cylinder and drum-wound armatures, and include machines with two, four, six and eight poles. Though I am not at liberty to publish the data in full, the general results are given. There is not so much agreement between the dynamos of different makers in respect to this relation as might have been expected, and for v we have all kinds of values, ranging from 200 to 1,000 times the diameter of the armature in centimetres. If full advantage of the length of the air gap were taken, and the thickest possible conductor used in each case, the diameter, to give a uniform temperature for all sizes, would be about proportional to the square root of the volume, but there are several reasons why this proportion should not obtain in practice. With this relation the ratio of the stray to the useful field would increase with the diameter, thus entailing an extravagant expenditure of energy in producing the requisite gap induction. Again, while the total field through the armature would increase simply as the diameter, the volume carried would increase as the *square* of the diameter, this being at variance with the well-established rule that the total field through the armature increases rather than diminishes relatively to the volume as the size is increased. It will be understood, of course, that precisely the same result is arrived at whether we consider the volume fixed and endeavor to find the best diameter, or consider the diameter fixed and seek for the best volume. It is simply a question of obtaining the most economical construction, having regard to cost of materials, efficiency, prevention of sparking, and temperature limit, though the figures at my disposal show estimates of the relative values of these factors to be by no means uniform.

Though the relation lacks definiteness to some extent, I find in the data of a large number of machines indications sufficiently pronounced to justify us in regarding the volume carried by the armatures of two-pole dynamos as proportional to the diameter for all sizes. In designing cylinder machines, the value of v may be taken as 400 times the diameter of the armature in centimetres, while for drum armatures the volume is obtained by multiplying the diameter by 600.* The cylinder armature has for a given volume a larger diameter, because of the influence of the interior wires. These being heaped inside to one and a half or twice the depth of the exterior winding, also being longer, a larger diameter is required for a given volume, both from efficiency and temperature considerations. Necessarily, the relations here given are not of a hard-and-fast character, and may be varied considerably. But whatever the proportion adopted, it is absolutely essential that the sparking limit already considered be not too closely approached.

In machines having four and six poles, the same average relation between the volume and diameter holds in practice for both cylinders and drums. In the calculations which follow these figures will therefore be adopted.

3.—OUTPUT OF DIRECT CURRENT ARMATURES.

If we call N the total number of lines of force entering the armature from all the poles, however many, and n the number of revolutions per second, the average E.M.F. generated in each conductor is, of course, $N\, n\, 10^{-8}$. If C be the total current flowing, each conductor will carry with the sections coupled in the ordinary way $\frac{C}{p}$ amperes, p being the number of poles. The electric work due to each conductor, is $\frac{C}{p} \times \frac{N\, n}{10^8}$; and the

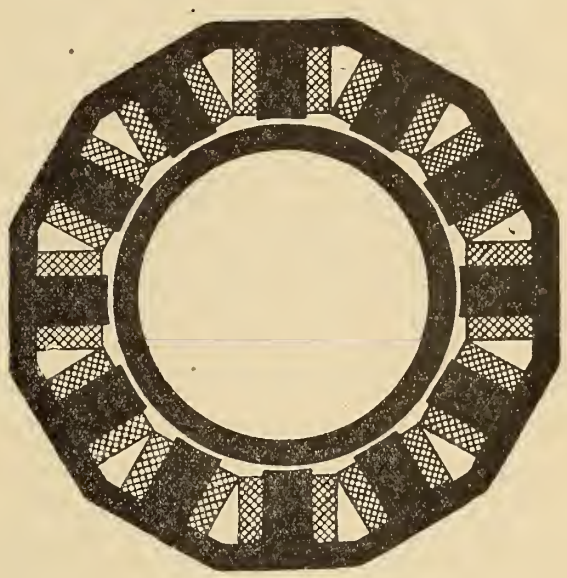


FIG. 2.

total work, $\frac{w\, C}{p} \times \frac{N\, n}{10^8}$, where w is the number of conductors, counted all round the exterior of the armature. The quantity $\frac{w\, C}{p}$ is what we have called the *volume*, and we get for the total electrical output in watts the expression,

$$W = N\, n\, v\, 10^{-8} \qquad (4)$$

which is quite independent of the manner of coupling up the armature sections. It will be evident, I think, that with the same relation existing between v and d for two, four and six poles, the output of an armature of given diameter and length, running at the same speed, is quite independent of the number of poles. It matters not whether N be furnished by two poles only, or by four poles of half the angular width provided its value remains unaltered.

The volume, then, may be expressed in terms of the diameter. The quantity, N, may be expressed in terms of the diameter × length of the armature. Taking an induction of 5,000 C.G.S. units per square centimetre in the air gap—a very usual figure—and assuming that the fraction of the armature circumference covered by the pole pieces = 2.25 d, we get, calling L the length of the armature in centimetres, 11,250 $d\, L$ as the total number of lines of force entering the core. Call this, in round

* In my last paper the number given was 570. This I now amend as above.—W. B. E.

numbers, 12,000 $d\ L$. Substituting for N and v their values, the output becomes for cylinder armatures

$$W = .048\ d^2\ L\ n \qquad (5)$$

and for drum armatures

$$W = .072\ d^2\ L\ n \qquad (6)$$

This applies to all direct-current machines, whether bi-polar or multi-polar; though it will be understood of course, that the induction in the gap may be greater or less than what has been assumed. In that case the coefficients .048 and .072 would be altered, without changing, however, the form of the expression.

4.—OUTPUT OF ALTERNATING-CURRENT ARMATURES.

The armature loads for alternators, though producing a cross magnetization, as in direct current machines, raise no considerations, of course, as regards sparking. But on account of the greater proximity of the poles, and the greater stray field resulting, it is desirable to make the layer of copper on the armature core as thin, and the air gaps as short as possible. As a consequence, probably, of the increased ratio of stray to useful field, the induction is less in the gaps of alternating than in those of direct-current machines. Here it will be assumed that the virtual induction is 4,000 C.G.S. units per square centimetre, meaning that this represents the induction to which the resultant E.M.F. is due. The impressed E.M.F. is greater than the resultant, and the induction due to the field magnets alone is greater than 4,000; but what I am dealing with is the field resulting from the inter-action of the magnet and armature fields; it is the field to which the resultant E.M.F = C R is due, this and the current being coincident in phase. Usually the poles cover a fraction of the circumference = 1.5 d, the value of N for alternators being then 6,000 $d\ L$. About half the circumference being covered with wire, under usual conditions of temperature and efficiency we have for v a mean value of 400, which gives for the product of mean resultant E.M.F. and mean current $= .024\ d^2\ L\ n$. In some cases, as in the Westinghouse machine, the conductors cover more than half the circumference, and v is therefore greater. But here, on account of the differential effect produced on the separate wires of the same section, the added turns have nothing like a proportionally increased value, and the expression will give approximately the value of the product of mean resultant E.M.F. and mean current, even in these machines. Assuming that the E.M.F. is a sine function of the time, to get the watts we must multiply by $\frac{\pi^2}{8}$, which gives us, therefore, as the output of the alternator

$$W = .0296\ d^2\ L\ n \qquad (7)$$

or rather over 40 per cent. of the work done by a drum-wound direct current machine having an armature of the same external dimensions. Some comparisons have been made of the output of direct and alternating machines of the same weight, but these, in the nature of things, must be misleading. The two types are quite unlike in their proportions, as Figs. 1 and 2 show, and no one would think of making them the same. Fig. 1 represents the magnetic system of a four pole direct, and Fig. 2 that of a twelve-pole alternating machine of the same output; and while it will be observed that the iron parts—core and yoke rings—are much heavier in the former, it will be noticed that the copper in the magnet coils is much heavier in the latter. In fact, though the iron in the alternator is only 55 per cent. of that in the direct current machine, the copper required is no less than 250 per cent. It is difficult, then, to understand what useful purpose is served by comparisons such as I have alluded to.

(To be Continued.)

The Royal Victoria Hospital, Montreal, is being wired for some 600 incandescent lights. This will be one of the most complete installations made in Canada and the first interior conduit work. The Royal Electric Company of Montreal have received the contract for doing the work.

The Queen's Hall, which was opened in Montreal under new auspices last week, is lighted throughout with electricity. The arrangements are very perfect. All the stage, border, foot, bunch and proscenium lights are controlled by separate switches, and have kicking coils or reducers for dimming the lights. This work was installed by the Royal Electric Company, of Montreal, and reflects credit on them for the novel features. The proprietors state that the electric light is far more flexible than gas, and there is much saving effected in insurance, besides entirely doing away with any heat in the building.

WAYSIDE NOTES.

(By a Travelling Correspondent.)

The town of Mitchell is now well lighted with electricity, Mr. John Byers being superintendent.

It is a pity more of the engineers in Berlin do not try and read English. They don't know what they lose.

Wallaceburg has now its electric light, the plant being under the superintendence of Mr. Martin Markins.

The town of Preston, comprising one street, is well lighted. The plant is owned by Mr. Tenwick, who also superintends.

The man who wanted a "certificate" with his paper still runs a plant in Guelph. He'll get one, if he reads the F. N. & S. E. J.

The branch of the C. A. S. E. in Stratford is now reduced to very few members. It is time the engineers outside took advantage of the Society.

Clinton is now a well lighted town, the plant being under the superintendence of Mr. Jonathan Brown and his assistant, Mr. Marshall Morvish. Clinton to a man takes the NEWS. Other towns and cities please copy.

Goderich is now well lighted, having 33 street lights and 40 arc lights in the stores, supplied by the town's Electric Light Co. Mr. W. H. Smith is superintendent, and the light gives great satisfaction to the town and store keepers.

The Stratford Water Works have now the whole of their pumps in working order, having a capacity of 374 million gallons per day. The plant is under the superintendence of Mr. Thos. Clark and his two assistants, Messrs. Corrie and Evans.

It is about time, with the material in the City of Guelph, that a branch of the C. A. S. E. was inaugurated. It was mooted, but seems to have died owing to the apathy of some of the men. There are still quite a few who want it if they could get a leading hand.

Engineer Thos. McCoughland, of the St. Clair Tunnel, is now prepared to pump fresh or bad air, or light the tunnel. The plant is now in working order and waiting for the completion of the tunnel. He has under his charge two 20 h. p. high speed engines, air and water pumps, and two Ball dynamos supplying 250 incandescent lights.

The Berlin Electric Light Co. are now in successful working order. They have two 25 light Ball dynamos, and will soon have a four ampere machine for incandescent and arc lighting, for which the Ball Electric Light Co. have the contract. They have 52 arc lamps in the city and stores. The plant is under the able supervision of Mr. Wm. Aldrich, who has many improvements of his own make on the plant.

The Stratford Electric Light Co.'s plant, which is under the able superintendence of Mr. Robert Wells, is now in full working order. The Company have the best supplied power in the county, consisting of a 75 h. p. Wheelock engine (Goldie & McCulloch's make), a gas engine and water power. They have three 35 and two 25 light machines, and now have in use 129 lamps, including 30 private contractors.

THE Guelph Electric Lighting Co. have now one of the neatest and best equipped engine and dynamo houses in the Dominion. They have one Royal and two Ball dynamos, which are worked by a turbine wheel (when there is sufficient water in the river). Failing this, the engine (Goldie & McCulloch) runs the plant, which is under the supervision of Mr. C. J. Jorden. The whole plant works successfully, and the city, stores, and hotels are well lighted.

The Chatham Gas Co. supply the town with electric light. The company have one Royal arc dynamo, 40 light, and one 500 incandescent light; one Ball dynamo, 25 arc light, and one Brush machine, 30 arc light. They have in operation 90 street lights and 300 incandescent lights. The plant is in charge of Mr. Albert Frott, with Mr. Lamon as general manager. The engineers here have a good chance of getting a branch of the C.A.S.E. Many men express a wish to this effect. The president of the Toronto branch will give them all the assistance necessary.

The St. Mary's Electric Light Co. is owned and run by Mr. L. H. Reesor, with W. T. Brown as electrician. They borrow their power, and have three Ball dynamos for incandescent lighting, and a 35 arc light dynamo. They supply 60 arc and 145 incandescent lights to the town and stores. They had a curious incident happen to the poles and incandescent lamps during a thunderstorm. Whilst the current was turned off, the lightning seems to have struck the wires, entirely burning out two lamps and splintering the poles. The St. Marys men don't seem to understand how it happened.

The thanks of this paper are due to the engineers in all the cities and towns visited for the very courteous treatment accorded to its representative. Many of them have gone out of their way to get him subscribers.

PRACTICAL SUGGESTIONS TO BE OBSERVED IN RUNNING DYNAMOS.

PLACE the oil catchers under the drip of the dynamo bearings, and never allow them to overflow on the floor.

Keep the floor of the dynamo room swept clean, so that no nails or other small pieces of metal can be drawn into the armature.

Never use or leave iron or steel tools near the machine, while at work, as these are also likely to be drawn into the armature if left too near it.

Oil cans made of copper or zinc are best for use about electrical apparatus.

Never allow oil to accumulate on the armature or shafts of the dynamo.

When the wires coming out of the shaft to the commutator become bare from cleaning, they should be re-covered with kerite or okonite tape, or gum cloth, and shellaced, and allowed to dry for about eight or ten hours before being used.

If the shellac on armature bobbins, or field magnets becomes worn off, these parts should be re-shallaced.

A good bellows will be of service in getting dirt out of the crevices of the armature, and around the commutator and rockers.

If the rocker springs are fastened to a wood base, see that the screws which hold them are kept tight as the wood dries.

See that all thumb screws in the binding posts are kept screwed down tight on the wires. Special care should be exercised in regard to this in the case of incandescence machines.

In placing brushes, take pains to clamp them firmly in position allowing them to rest squarely and evenly on the commutator. Be very careful not to screw down one side of the clamp tighter than the other, but clamp them evenly, so that both edges of the brushes will be held in place.

The clamps holding the brushes must be perfectly clean, so as to make good contact.

Brushes must bear on the commutator with a reasonable pressure, not too hard, nor so lightly as to allow them to flap or chatter. Occasionally, by accident or otherwise, the brushes will get bent, or sprung, and bear too lightly on the commutator. This condition of affairs is always attended with many sparks, and a very rapid cutting, or wearing, of commutator segments. In fact, segments may be worn out in a few days in this way.

If brushes are perfectly straight when put into the clamps, sufficient pressure will usually be obtained.

In an arc light, or high-tension machine, if the brushes are rocked too far forward in the direction of rotation of the commutator, the sparking will quite disappear, but the lights will go out occasionally, each extinction being attended by a few very long sparks on the commutators. This trouble may be corrected by rocking the brushes backward a short distance. If brushes are moved too far back, there will be sparking, and a consequent diminution of light in the lamps, and occasionally extinctions of the lamps, similar to those which occur when the brushes are too far forward.

The proper point for the brushes is as far forward as possible, so as to make the sparks small, and yet back of the point where flashing will occur. In low-tension, or incandescence, machines, the brushes should be adjusted to show no spark, or only a very minute one, otherwise the wear on the commutator and brushes will be very heavy.

Too much oil on the commutator will cause sparks similar to those which appear when the brushes are not properly adjusted.

When brushes are worn nearly through, clip them off squarely at the worn ends, and move them up to the same position as before.—*Western Machinist.*

SPARKS.

Electric propulsion has gained favor rapidly among the enterprising population of British Columbia. A line runs (four miles) from Victoria to Esquimalt; a line is projected to Saanich, a farming section, a distance of eight or ten miles; an electric tramway is being constructed from Vancouver to Westminster, 12 miles, to carry freight and passengers; another line has been surveyed south from Vancouver to Ladner's Landing; electric tramway charters have been obtained for Nanaimo, Vernon, Nelson and other places in the province.

A few days ago a middle-aged man entered the office of the Pittsfield, Mass., electric light station on business bent, says the *Journal* of that city. He produced a quart bottle and asked to have it filled with electricity. The genial manager of the concern soon discovered that the purchaser was in dead earnest, and further questioning revealed to the electrician, always on the alert for something new in his line, that the middle-aged man aforesaid had discovered a new use for the mysterious and, as Webster calls it, "subtle fluid." He with the bottle went on to explain that he had been told it was the best remedy known to remove lice from cattle, and that it could be bought in Pittsfield at the electric station for six cents a gallon. He only wanted a quart of it and was anxious to get it and be off. He was finally convinced that he had been imposed upon, but did not express himself on the subject of practical jokes. It is understood that the imposee has left Pittsfield.

A correspondent of the Montreal *Star* publishes the result of a recent interview with Dr. Selwyn, director of the Dominion Geological Survey, who is engaged experimenting on a new material for insulating purposes. The doctor was found with a long narrow box before him, which was filled with lumps of a peculiar black earthy substance glittering with sandy particles. It was not unlike lumps of brown, sodden coke. "This," he said, "is a sample of petroleum saturated sand which is found in almost immeasurable quantities in the Athabasca district, and for which, I believe, I have found excellent and practical use. It can, I have no doubt, be used to great advantage for insulating electric underground wires. Its insulating power has already been tested by Mr. Gisborne, Dominion Electrician, who says it makes a perfect insulator, and I am now about to make further tests to see how it will stand the frost and weather. The discovery of this sand is not new it having been known to and described by Sir Alexander Mackenzie, a hundred years ago. It has already been referred to in the Survey reports, and petroleum experts have given it as their opinion that a large amount of petroleum could be extracted from this great body of sand if the proper appliances were secured. It has also been referred to as a possible fuel; but its projected use as an insulator is new. It is about 170 miles from Edmonton to the sand regions, and as the Calgary and Edmonton road is now being built to Edmonton, it would, I believe, be built to Lake Athabasca, should the sand prove useful, as expected. In the Athabasca district are also found good indications of sulphur, gypsum, salt and lignite coal.



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Superintendent's Office, Water Works Dep't,
TORONTO, January 6th, 1891.

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LAMINATED STEEL PLATES.

In the February issue, says the *Locomotive* we illustrated a laminated steel plate that came to our notice some time ago. At the time we first received the plate it was generally believed that steel was not liable to blister, since it is rolled directly from the ingot, and should, therefore, be entirely sound. Within a year or two, however, several instances have come to our notice, in which steel plates have been badly laminated. The cuts given in this issue illustrate two such cases.

Fig. 2 shows a plate that was cut out of a steel boiler that had been in use only six weeks. A blister developed on the lower side of the second fire sheet. It was raised about three inches at the highest point, and as nearly as it could be judged by the eye it covered an area of about twenty inches square. On cutting it out, however, it was found that the lamination extended in a thin line so as to separate the plates over an area about thirty inches wide and thirty-six inches long, the plate being so evenly separated as to closely resemble two plates, laid one upon the other. This appearance is represented in the cut. The outer layer, being exposed to the fire, had bulged over part of its extent, while the inner half showed no change in form and was free from any scale or deposit. The workmanship on the boiler is first-class in every respect, and the material was evidently intended to be, as the brand of one of the best mills in the country is stamped *directly on the blister.*

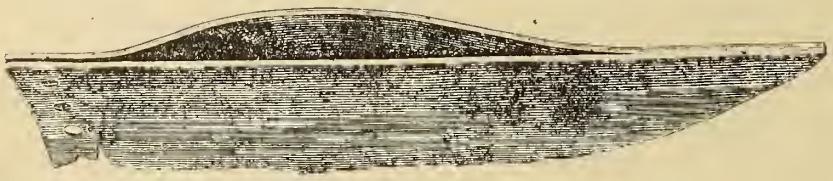


Fig. 1.—Laminated Plate Cut from a Steel Boiler.

Some correspondence passed between this office and the makers of the plate. A few extracts from it are appended. "We are very sorry," writes the manufacturer, "to learn of the lamination having occurred. It is not the result of any attempt to weld the steel, as some people suppose, but in casting the steel ingots bubbles or blow holes will be confined in the mass sometimes, and, of course, when the ingot is rolled out, the surfaces are flattened together, leaving what appears like a blister, sometimes large, sometimes small. In the earlier days of steel making we found frequent cases of this kind, but in recent years skill and experience have enabled the steel men to largely overcome it. We watch constantly for it, however, in examining and hammering our steel plates, but in this case the surfaces were evidently so closely in contact that the hammer did not detect any flaw, either with us or with the inspector at the boiler shop; and it did not show up until the heat separated the surfaces."

The piece of plate was cut apart through the middle of the blister, as shown in Fig. 1, and one-half of it was sent to the maker for examination. He says: "The plate shows up very badly, and is certainly a very unusual specimen. In all our years of experience in the steel plate business we have not seen its parallel; but we have seen defects of the same character, though much less extensive. It was caused, no doubt, by slag confined in the ingot. About nine years ago we bought some fire-box steel for a boiler for our own use, from a reputable manufacturer who sells a great deal of material throughout the New England States. Five plates out of the lot had to be rejected on account of blisters, and yet they were sold as the best open hearth fire-box steel. Such defects are likely to occur in the case of ingots poured from the top. It is now considered much better to pour from the bottom of the mold, through a pipe placed alongside and connected to the molds by underground channels. Our rolls are cast in the same way. The metal flows more freely, and without splashing; and any impurities contained in it will rise to the top more readily, and remain there." Again he says: "The case, we think, is the worst one that has ever escaped our hands; and we admit that to one acquainted with the difficulties in the manufacture of steel ingots it has the appearance of an attempt to weld steel together. In any case of this kind, however, the weld would gradually weaken and not come to a definite termination. One could readily satisfy himself on this point by cutting of a portion and splitting it back to the end of the fold, and noting how suddenly the solid metal begins."

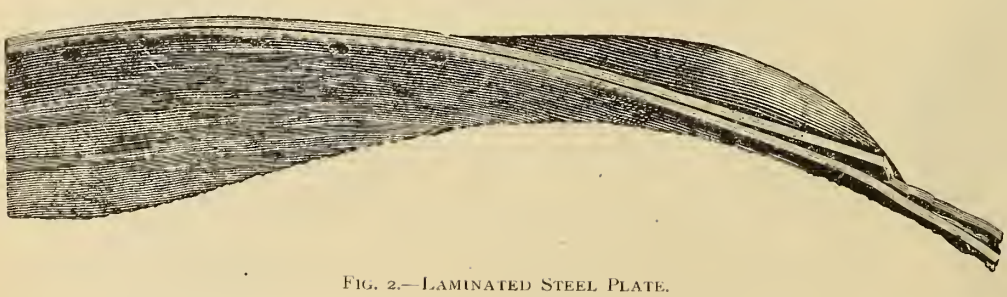


Fig. 2.—Laminated Steel Plate.

It is possible to leave too much of the top of the ingot in cutting off the crop ends of the slabs intended for plates. If the plates are sheared too close to the edge of the plates as rolled, lamination may appear on the edge of the finished product. This does not seem sufficient, however, to explain such extensive internal separation as in the present specimen.

In Fig. 3 a very curious blister is shown. It occurred some time ago on a boiler that was supposed to be constructed of steel, though at the time, not having had any such experience, we had some doubts about it being steel. The singular feature about it is the fact that it should have bulged so nearly equal in both directions. It has been suggested that a small fissure may have connected the original line of separation with the interior of the boiler, and that water penetrated the plate through this fissure, forcing the plates apart when it was afterwards turned into steam. This assumption looks reasonable, provided the fissure through which the water entered was very small, so that steam could not pass out of it very rapidly. Very likely, if this explanation is correct, the blister was developed gradually, by the entrance of water every time the fires were drawn, and its subsequent evaporation when the fires were again started. In the original specimen numerous small blisters could be seen on the interior surfaces of the large one.



Fig. 3.—Curious Blister from a Steel? Boiler.

TRADE PAPERS AS ADVERTISING MEDIUMS.

As indicating the important position which trade and technical papers occupy at the present time, says *Office*, it may be mentioned that the managers of the advertising departments of the prominent daily papers are at present instructing their canvassers to give no attention whatever to soliciting lines of business in which the general public is not interested, and in which the services of a trade paper would be more likely to bring results than a daily paper. The rate is so closely followed by a number of the leading papers of the country that it may be accepted as the general policy of the newspapers of the day. Trade papers are constantly occupying a higher place in the estimation of the business public, and more particularly in the estimation of the manufacturers and wholesalers who use them, and upon whose patronage they depend for support. While trade papers a short time since consisted of little more than mere advertising pages, with random clippings from various sources, they are at present the result of large corps of able and experienced writers; and, taken collectively, they exhibit more originality and more enterprise than perhaps any other class of periodicals at present published, not excepting the leading literary magazines.

SPARKS.

The Council of Thorold, Ont., have added to their electric plant a new dynamo for incandescent lighting.

The electrolytic method of sewage disposal would, it is believed, successfully solve Toronto's sewage problem.

The New Westminster, B. C., Electric Tramway Co.'s power house contains two dynamos and a 250 h. p. engine.

The Bell Telephone Company have recently been engaged in constructing a new line between Orangeville and Wiarton, Ont.

The citizens of Alexandria Bay have formed a stock company for the purpose of lighting the village throughout the year by electricity.

After a hard-fought contest, the Ball and Heisler Companies have secured the order for the electric plant required to light the town of West Toronto Junction.

The Eureka Tempered Copper Company, of North East, Pa., is having to enlarge its factory facilities to enable it to keep pace with the extraordinary demand for its specialties.

The citizens of Shelburne, Ont., celebrated with brass band accompaniment the advent of the electric light upon their streets. The plant consists of 25 arc and 19 incandescent lamps, and a 6-ampere dynamo, and is owned by Dr. Norton and Mr. Jelly. Mr. John Anderson will be in charge.

A method of blasting by electricity has been tried in Sweden, says the *Electrical Review*, with good results. The means consist of a voltaic arc produced between two carbon rods placed parallel. When the arc is moved close to the spot to be blasted, an intense local heat is created, resulting in expansion that splits the rock.

One of the most delicate duties which the electrical man is called upon to perform is to set aright the mind and money of some lay friend who rejoices in the possession of a secure position on a "ground floor," totally unmindful of the existence of a yawning cellar and perhaps subcellar beneath.—New York *Electrical Review.*

In his recent address before the members of the National Electric Light Association, Prof. Elihu Thomson gave the folowing lucid and interesting account of the building up of an arc:—Let us suppose the case of two carbons touching each other with a current passing, and that we then very slowly separate them, stopping to observe the effects. When the contact is light, before actual separation, a visible heating of the meeting ends is seen. On attaining a small separation, the space between seems filled with hot vapor, and we have a short arc where the separation is perhaps not over two or three one-hundredths of an inch. There is also noticed an active transfer of carbon from the end of the positive, and a deposition of carbon on the end of the negative carbon. This deposited carbon takes the form of a mushroom after a time and finally breaks off. Meanwhile combustion goes on at both poles and wears away the sides of the positive carbon, while the transfer of carbon wears away its tip or crater. The burning also wears away the negative at the sides, while the tip is built up by the mushroom deposit from the arc. But the cutting in of the negative finally severs the mushroom tip and it falls away. Hence, both carbons are eventually consumed.

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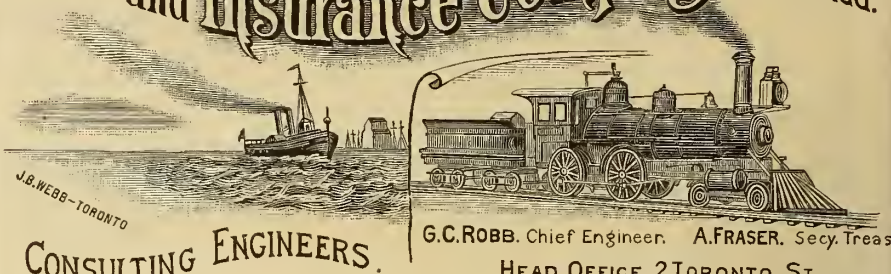
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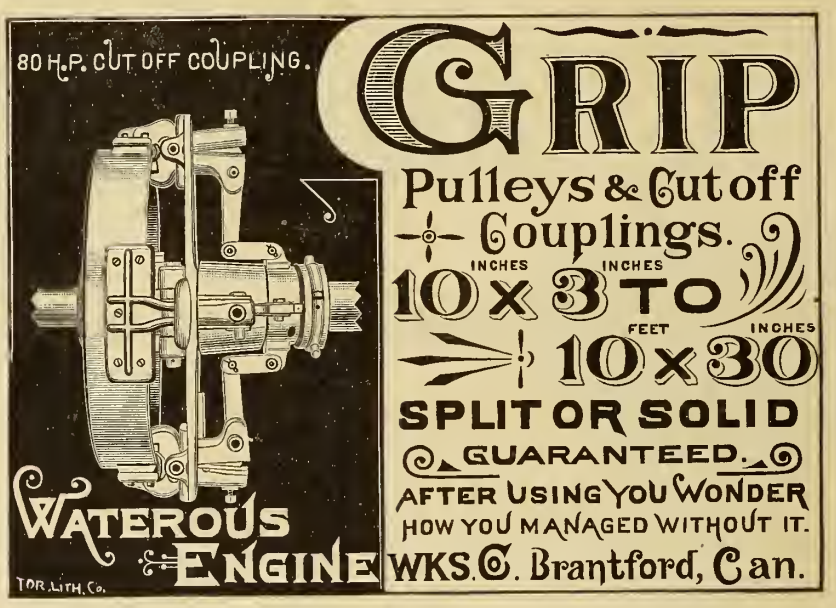
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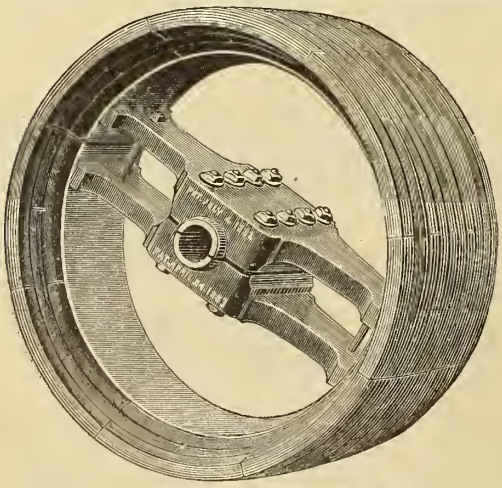
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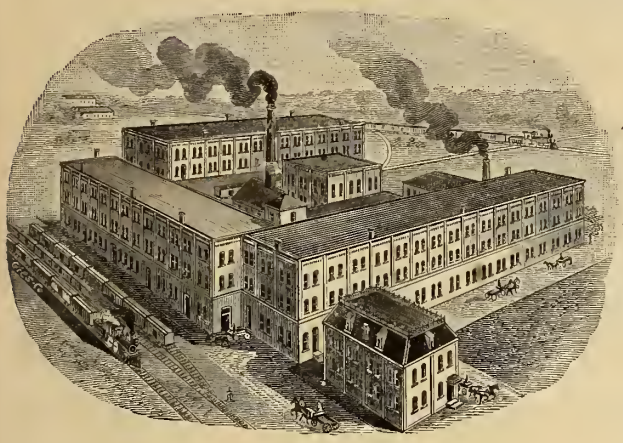
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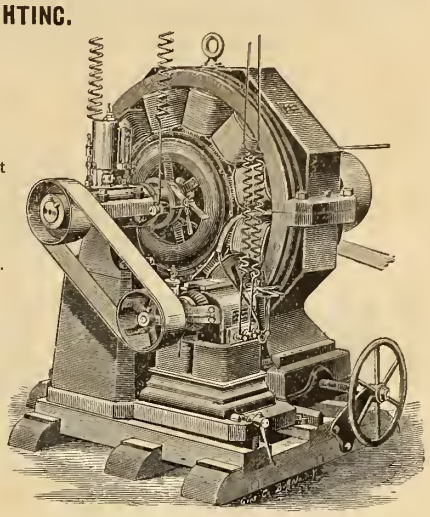
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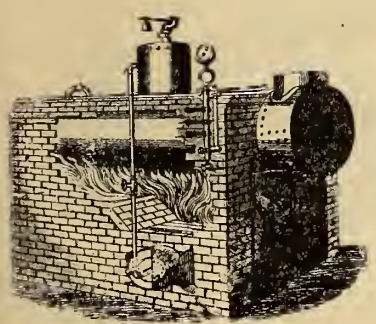
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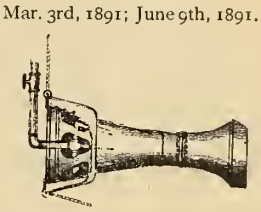
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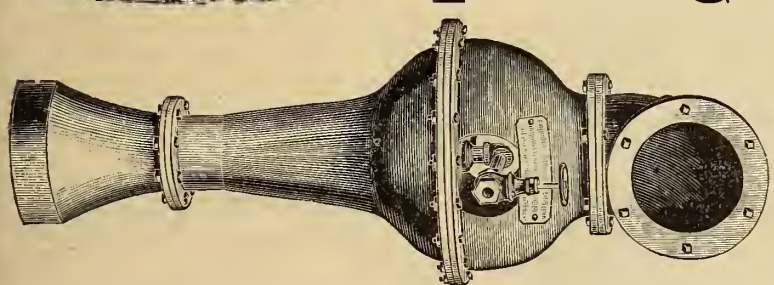
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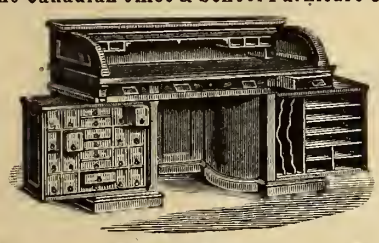
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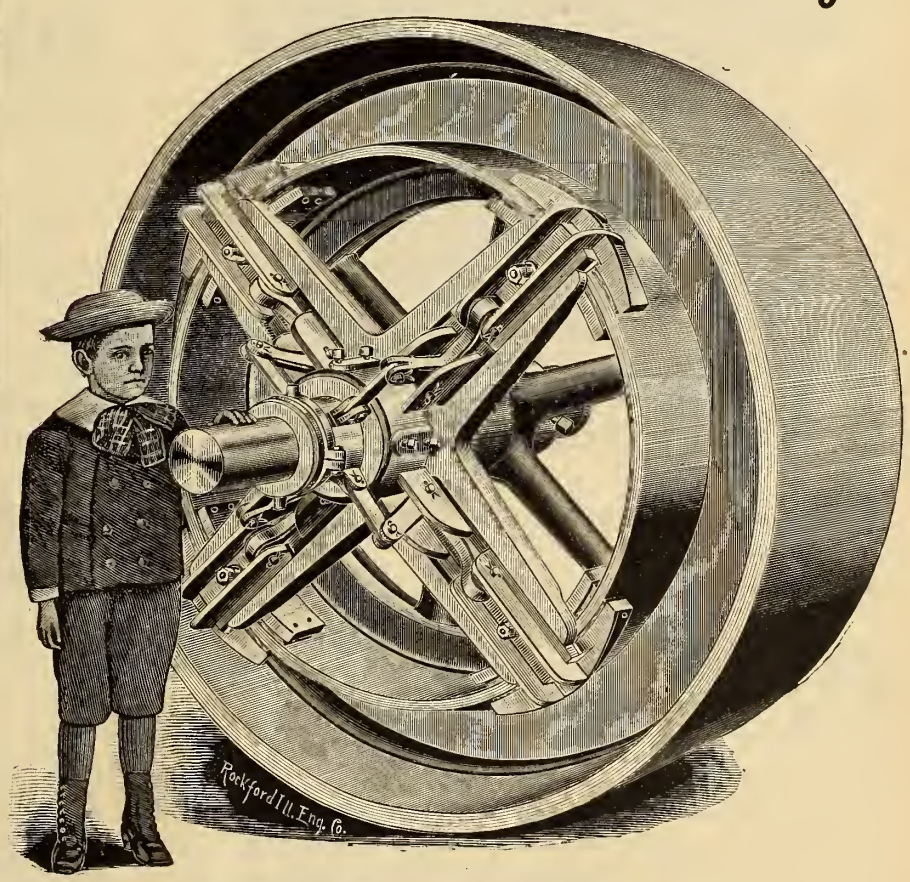
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SPARKS.

The shareholders of the Cowansville, Que., Electric Light Co., announce their intention to dissolve the company and wind up the estate.

A sub-committee will recommend to the Montreal City Council that permission be granted a company to build and operate an electric railway from the city limits at Mount Royal avenue to Craig street.

The capital stock of the Sherbrooke Telephone Association will be increased by $10,000. Mr. J. A. Archambault has been elected president, Mr. S. W. Jenckes, vice-president, and Mr. C. Skinner, managing-director.

Special transportation rates will be granted the delegates to the Montreal electrical convention by the railroad and steamboat companies. The minister of customs has stated that all electrical appliances for the Exhibition will be admitted from the United States duty free.

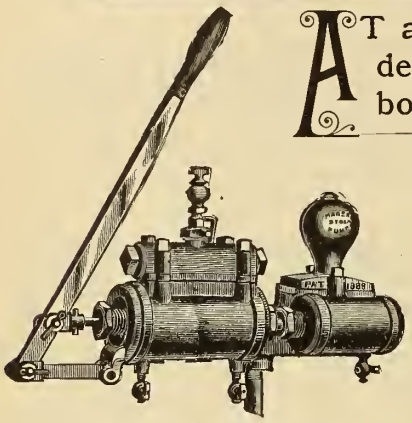
Mr. Henry Leeds, of New York, visited Ottawa recently, for the purpose it is said of arranging with Messrs. Holland Bros., Canadian agents of the North American Phonograph Co., to place on the Canadian market a number of phonographs on the nickle-in-the-slot principle.

Experiments having in view the showing of the difference of cost between hand welding and electric welding have recently been made in England by an eminent firm. The result shows that the amount of work which by hand cost $45.77, when done by an electric welding machine cost only $30.25, an actual saving of $15.52, and the work was very much better and more soundly wrought.

MARSH INDEPENDENT STEAM PUMP

FOR STATIONARY, PORTABLE AND MARINE BOILERS.

OVER 2,000 MARSH PUMPS SOLD IN THE UNITED STATES DURING 1890



THIS CUT SHOWS SMALLEST SIZE MARSH PUMP, WITH HAND LEVER.

AT a recent test by Prof Cooley, of Michigan University, 48 degrees of temperature was added between condenser and boiler in passing through pump.

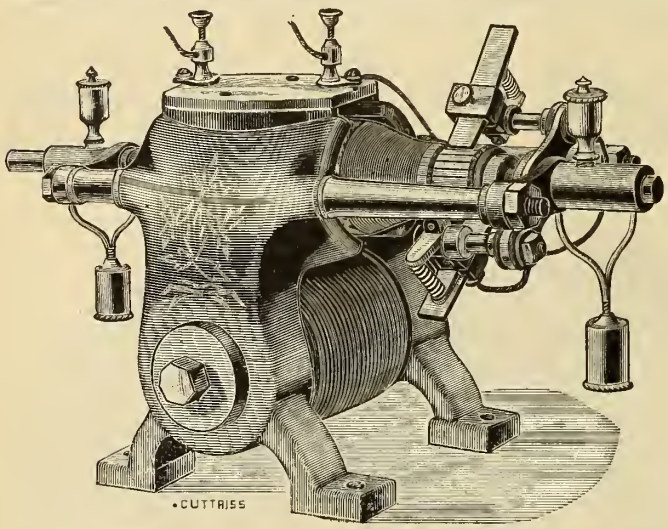
Absolute Actuation and Regulation without the use of Tappets, Levers, or other Mechanical Construction.

As the exhaust mingles with feed water and returns to boiler, there is no loss of heat, hence it is the most economical pump in use. For hot or cold water or liquids, with or without Hand Pumping Attachment, NO PUMP EVER MADE THE RECORD OR BECAME SO POPULAR AS THE "MARSH."

Patented in Canada 7th February, 1889.

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SPRAGUE MOTORS

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T. W. NESS,

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Canadian Headquarters for Electrical Supplies.

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ELECTRICAL NEWS

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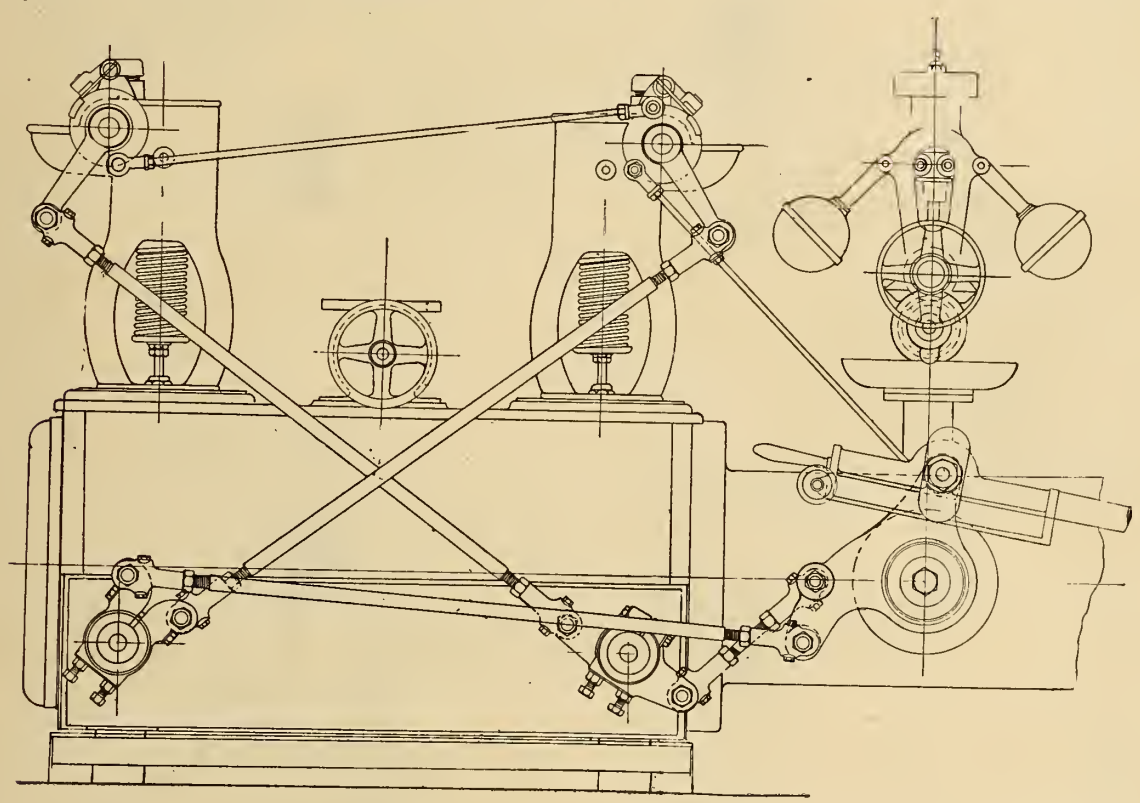
VOL. I. TORONTO AND MONTREAL, CANADA, AUGUST, 1891. No. 8.

NORDBERG POPPET VALVE ENGINE.

THE Patent Poppet Valve Engine, illustrated herewith, is the product of the long experience and careful study of Mr. Bruno Nordberg, who for a number of years was the chief designer with the Edward P. Allis Co., Milwaukee, Wis.

The designer claims that it is constructed to meet the increasing demand for greater rigidity, strength, and durability of wearing parts. On account of the small tips of inlet valve, the latter will drop very quickly, enabling the engine to be run at a speed up to 150 revolutions per minute.

The shape and location of the wrist lever permits of a very short distance between centre of shaft and foundation, being on a 20 inch engine, only 22 inches, while that on some other engines of same diameter of cylinder is 30 inches. This, it is claimed, lessens the strain on the foundation, by reducing the tendency to rock it endwise, communicated by the momentum of the reciprocating parts.



The frame is of the girder pattern, cast in one piece with the main bearing and slide.

The post under the main bearing is considerably wider than the length of the bearing, and in it is provision for four bolts.

In designing the cylinder, the object kept in view was to increase the inlet valve area, and at the same time reduce the clearance. The clearance in the valve cavities is a great deal less than those commonly made. That of the exhaust valve is reduced nearly one-half, this result being obtained by its location and peculiar construction.

The external valve gear presents a great many radical improvements, as can be seen by cut. One feature of this valve gear is that the setting of the exhaust valves can be adjusted without changing the length of the valve rods, i. e., without disturbing the motion, by changing the angles through which the valves are intended to move.

Darling Bros., Montreal, who are manufacturing the Nordberg automatic governor, are the sole makers of this engine in Canada.

STEAM ADMISSION.

III.

THE valve being arranged to admit the steam in sufficient quantity and at the right time, the next point to consider is how long should the steam continue to flow in, or should it be cut off?

There are many different ideas held on this subject, and when high pressure steam came first into use many thought that the sooner it could be cut off, the better the result. Some engineers still hold this idea, and it would be a correct one were steam cylinders made of a material that was perfectly impervious to heat and quite unaffected by any change of temperature. Were it possible to make the cylinder of a material which once heated to the same temperature as the newly admitted steam would remain so, and not cool down, then a quick, sharp, early cut-off would be economical. But as cylinders are made, they absorb heat from the fresh steam, and thus a portion of steam is condensed. Then as the cut-off takes place, and the steam is expanded, the heat is returned by the cylinder and some of the water is again made into steam when it is too late to do any work, and so the heat taken out of the fresh, live steam, is thrown away. The greater the difference between the temperature or pressure of steam admitted to the cylinder and the temperature or pressure of the same steam when let out of the cylinder, the greater the loss from this cause. It may not all be carried off by the work of re-evaporating water, but some of it is wasted in doing that, and some of it in simply raising the temperature of the exhaust steam and water. Many experiments have been made to determine the best point of cut-off, and it may be taken as a result of these, that there is no economy in cutting off so

early that the steam is expanded more than about five or six times in one cylinder.

Another very necessary point to determine is the pressure at which the exhaust steam is to escape. If the exhaust is to discharge into a feed water heater when there is a pressure of, say, 2 lbs. per square inch, then it is wasteful to make the cut-off so early that when the exhaust valve opens, the pressure in the cylinder is lower than that in the heater. Or if the discharge is directly into the air, there is no economy in having the steam expanded in the cylinder to a pressure below the atmospheric pressure.

The better way to determine the point of cut-off is to construct an indicator diagram by fixing the amount to be allowed for each pressure, the pressure at the time exhaust is to open, and by drawing an expansion curve; then the size of cylinder and pressure of steam may be readily found for any required horse power if the speed of piston is known. It will be sufficiently accurate to calculate the points for the expansion curve by the rule that the pressure multiplied by the volume produces a constant quantity. Perhaps it would be better to describe the process of drawing a supposed indicator diagram.

First draw to parallel lines with a distance between them equal to 15 lbs., as measured by whatever scale has been chosen, such as 32 lbs. to the inch; then draw eleven parallell lines at equal distances apart, and at right angles to the first two lines. These eleven lines will divide the diagram into ten divisions. All measurements and calculation of pressures has to be made from the bottom line of the two first drawn. It represents the line of no pressure, the upper one representing the atmospheric pressure. The length of the diagram represents the length of the cylinder, multiplied by its area, which gives the volume of steam. This may be measured either in inches or feet, and care must be taken not to measure the area by inches and the length by feet.

Let it be determined that at end of stroke the pressure in cylinder is to be two lbs. above the atmosphere, then on the eleventh vertical line mark off two lbs. above the atmospheric line or 17 lbs. above the line of no pressure. Then the pressure of any other line can be found by multiplying 17 lbs. by the volume at end of stroke anddividing by the volume at the line for which the pressure is required. Having marked off the pressure thus found at each line, draw a curved line through all the points, this curved line will represent very nearly the actual expansion of the steam. Then at the first vertical line mark off the pressure of steam which can be admitted to the cylinder, an draw a line parallel to the atmospheric line till it cuts the expansion curve, this will represent the steam admission line of the diagram, and where it cuts the expansion line is the point of cut off required, in order that at end of stroke the presshre shall be 2 lbs. above the atmosphere, if the valves and piston are all right.

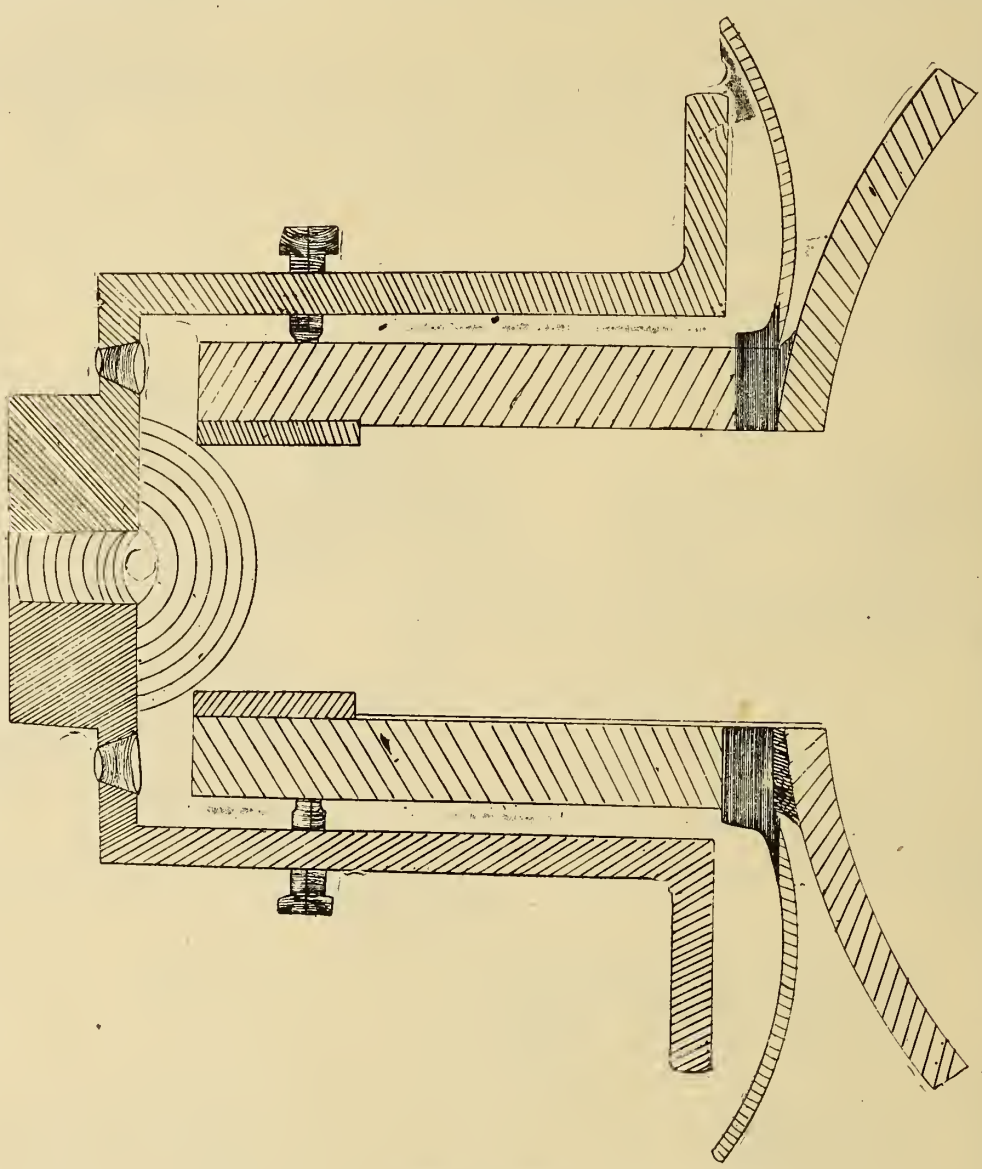


Fig. 1.—Valve in Operation, Shewing Inside View.

ERRORS OF SAFETY VALVES.*

The ordinary lever safety valve in use on ordinary boilers in nearly all sizes of boilers I have had charge of are about all the same class of safety valves; they call them "3-inch." Now we will see what "3-inch" is.

On boiler pressure 75 lbs. per square inch, and also the flow of steam in atmosphere, 3×3, that is 7·6. Now then, 75 lbs. per square inch under valve, 7.6×75.570 lbs. dead weight on the valve stem. Now you set your weight on your lever according to your figures, then you test your boiler, and finding your weight is heavy, you say there is something wrong. Well, what is wrong? It is the valve seat; there is a bridge in that seat, ½" × 3", to guide the valve and to keep it in place. When it rises and drops that bridge—½" × 3"—reduces area of valve from 7.6 to 5.94 dead weight on valve, the stem would be about 445 lbs.; therefore, with friction 125 lbs. less than your figures (and that would not be the worst in reducing area of valve); by that bridge in seat you reduce the flow of steam in atmosphere. That is the error.

This valve I show you was designed in England some time ago. It was designed to do away with the lever and weight, and you will see by the design rivetted on the boiler — in the usual way, double rivetted — it is not only a proper, but what we are figuring on, a 3-inch valve. Should anything occur suddenly, requiring the full area and capacity of flow of steam as quickly as possible, this valve will do all that a 3-inch is called upon to do, for there is no friction. I think we should look after our boilers and safety valves more than we do.

The Edison General Electric Co. will fit up the new Manitoba Hotel at Winnipeg with combination electric and gas fixtures.

The Canada Electric Co., of Amherst, N. S., reports the following central station contracts: The Sydney Gas & Electric Co., 600 incandescent; Antigonish, N. S., Electric Co., 400 incandescent; H. A. Smith, Digby, N. S., 300 incandescent; all the above are direct current system, economic lamps, insulite sockets, using the Canada Electric Co.'s standard dynamos. We also have closed with the Gardiner Mines Co., of Cape Breton, to install a complete wire cutting plant, Jeffery undercut machines, and C. E. 40.000 watt, 220 volt generator will be used.

*Paper read before Montreal Branch, C.A S.E., by Mr. John Oades, M.E.

A ROUGH-AND-READY DYNAMOMETER FOR SMALL MOTORS.*

I HAVE been requested to bring to your notice a friction-brake dynamometer that is by no means new, but is one that is deserving of being more widely known by electricians than appears to be the case.

Like the well-known Prony brake, it acts as an absorption dynamometer; and without detracting from the acknowledged value of this instrument, especially for testing the value of large prime-movers, yet we need something more portable, more convenient to use, in the very numerous cases where it is desirable to test the efficiency of small motors.

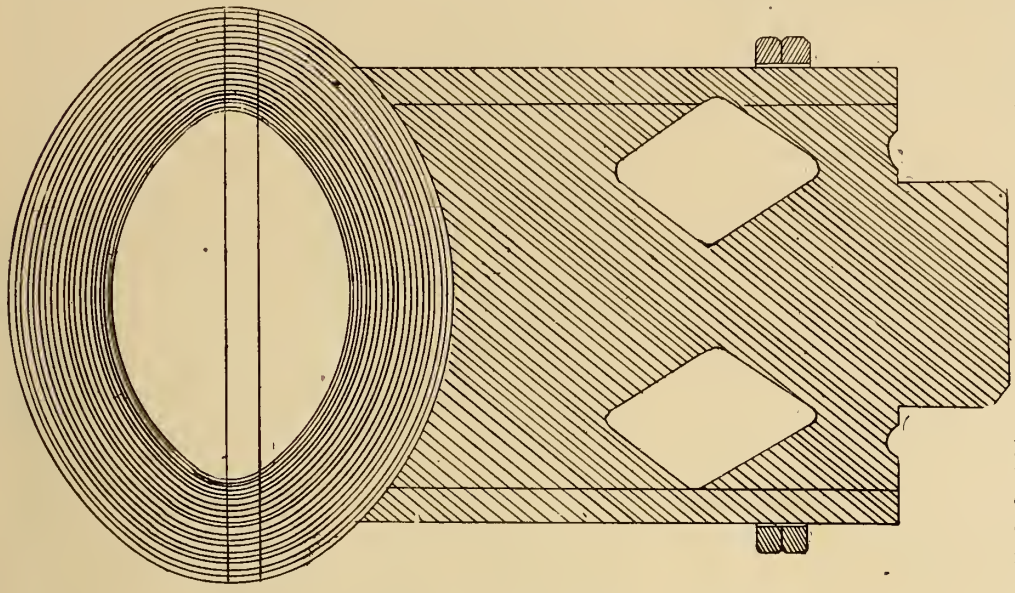


FIG. 2.—CHAMBER, SHOWING VALVE ATTACHED.

We need a rough-and-ready instrument that is portable, inexpensive, readily used, and at the same time reliable.

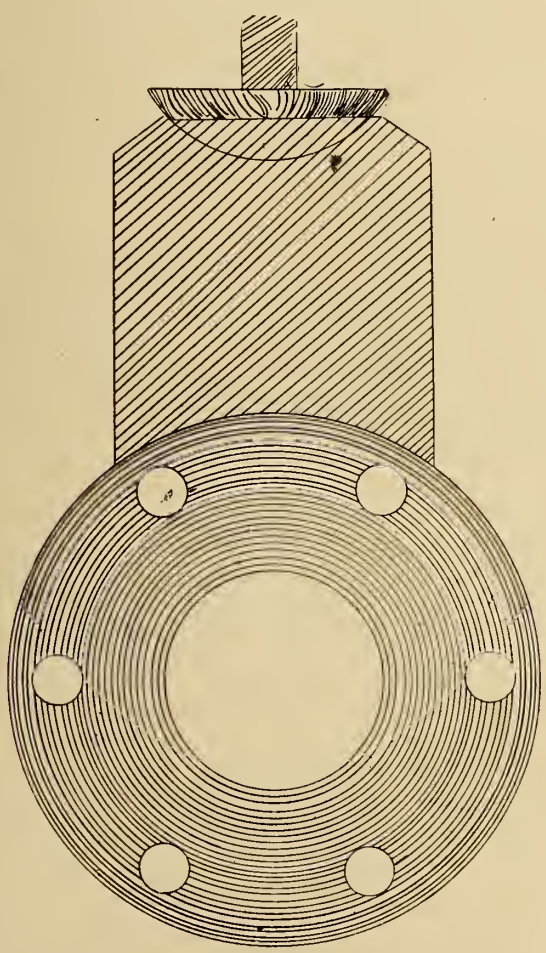


FIG. 3.—SHOWING COVER THAT BALANCES THE VALVE.

This we find in a friction-brake dynamometer, one of the many modifications of those illustrated by Mr. Wm. Worby Beaumont, in his paper on friction-brake dynamometers, read before the Institution of Civil Engineers, London, November 13, 1888, and published in 1889 in the Proceedings of the Institution.

Its construction requires only the use of a leather belt with a spring balance attached to one end, and a suitable weight to the other. The belt is to be thrown over the belt pulley of the motor, the spring balance is fastened to the floor base, or support of the motor to be tested, and the weighted end hangs pendant on the side of the pulley which, when in motion, will tend to lift the weight. When the motor is at rest, the strain of the weight should be read off the spring balance. This reading we will call W. When the current is switched on and the motor is run at a speed, the spring balance should again be read off, since the friction of the pulley on the belt will have a tendency to raise the weight; this reading we call W'. The difference between W and W' in pounds, multiplied by the circumference of the pulley in feet (including one-half the belt thickness on each side), and this by the number of pulley revolutions per minute will give the foot-pounds of mechanical energy, which can be compared with the electrical energy required to produce it, in the usual manner.

Thus, in a few minutes with the aid of a speed counter tachometer, a voltmeter and an ammeter, the efficiency of a motor can be determined, and its ability to do a desired amount of work ascertained at once, instead of being left to guess-work, as would be the case if more bulky or elaborate apparatus were needed.

It should not be imagined from these remarks that this form of dynamometer is applicable to small motors only; but it is evident that for testing larger machines where many horse-power have to be measured, the apparatus needs more elaboration, especially in the use of friction blocks, under the belt or pulley strap, their lubrication, and the use of a dash-pot to steady the brake when the motive power is irregular.

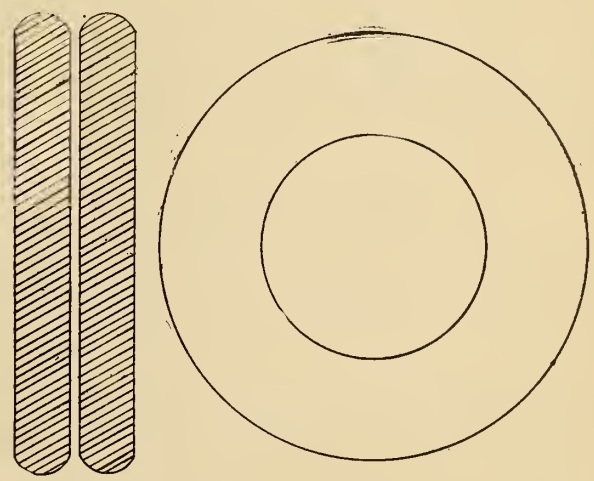


FIG. 4.—SHOWING THE WEIGHTS THAT FIT ON THE COVER, SHOWING TWO VIEWS.

But I need not enlarge on this, except to say that in these particulars, whether using steel strap, or leather belting with friction-blocks, or rope friction, the same care is needed as in the Prony brake to obtain correct readings.

* From a paper read by John Hoskin before the Franklin Institute.

A recent despatch from Kingston Ont., says a successful test has been made of a new diver's telephone invented by Mr. A. F. Smith, of that city.

The Dominion Parliament has passed a Bill incorporating the Anglo-Canadian Electric Storage and Supply Co. The projectors are. Francis Clemow, Charles H. Mackintosh, J. A. Gemmill, J. W. McRae, William McDougall, C. B. and C. C. Ray, of Ottawa, and Arthur Shippey and Henry Woodward, of London, Eng. The capital stock is placed at $50,000, and the headquarters of the company at Ottawa.

H. P. OF ENGINES.

TORONTO, July 23, 1891.

Editor ELECTRICAL NEWS.

In your July number C. W. Ross is again in print concerning horse power. From his statement that he is writing for the young engineer in the first of his letter, it is reasonable to expect he would make his case plain, but the whole letter is so mixed up that I would rather take my chances with formula and get my knowledge from them than from the muddle he has got the matter into. The young engineer knows that 33,000 lbs. raised 1 ft. high or moved through 1 ft. of distance in one minute is equal to or the equivalent of 1 horse power. This rule he applies to all forms of calculation of power ; it does not matter to him what the immortal Watt concluded a horse actually did accomplish. It is not even necessary that he should know by what means the rule was established. His natural ideas of the application of power to work will show him that he can accomplish the same amount of work by making the load lighter and moving it farther per minute. The statement Mr. Ross makes, and which is printed in italics, says that a h. p. is a power that can raise 33,000 lbs. 1 ft. in one minute travelling at the rate of 220 feet per minute. Now, what travels 220 feet per minute. Why, the horse, of course. Still, he is only moving the load at the rate of 1 foot per minute; this don't fit some way. The load moves as fast as the horse does, no matter what its weight is or what the speed he travels at. Still Mr. Ross tells us to use both 1 ft. per minute and 220 feet per minute in connection with his 33,000 lbs. If I tell my boy that Jim Johnson's horse is going 220 feet per minute and that he is pulling a load after him of 150 lbs.; that horse is exerting one h. p., because 220 feet × 150 lbs. = 33,000 foot pounds, which = 1 h. p. This would establish in the boy's mind what a foot pound is, and he would know that if the horse was very strong and a good puller and could draw 33,000 lbs. along one foot per minute, he would also exert just 1 h. p. A racehorse to go a mile in 2½ minutes travels at the rate of 2,100 feet per minute, and if he pulls a load of 16 lbs. after him, he is exerting a power = to 1 h. p., *i. e.*, 33,000 lbs. 1 ft. in 1 minute. Our friend Ross will do far more to enlighten the young engineer if he drops the 220 foot business, and lets the speed that a *horse can work at* go to the dogs. Accept the formula as it is to-day used—33,000 lbs. × 1 ft. × 1 minute = 1 h. p. Let matters of experiment by Leslie or any other expert who was trying to find out what a horse could do go with the rest. The young engineer is not interested in knowing whether a horse can do more or less ; all he needs to know is that formula, 33,000 lbs. × 1 ft. × 1 minute, is the standard of measurement for a h. p. as used to-day. When a man gets to know so much that he is splitting hairs over things that have no real bearing on the h. p. of a steam engine, he is not useful to the young engineer, or the old one either for that matter.

N. GINERE.

THE OTHER SIDE OF THE SUBJECT.

Editor ELECTRICAL NEWS.

DEAR SIR,—I am a good deal surprised, and I may say, pained, to observe the bigotry and intolerance manifested by your correspondents "Safety" and "S" in their letters in your last issue. Presumably, from the tenor of their remarks, they are of the elect. They only know how it should be done—no one outside of the charmed circle knows anything about it. Now I would like the president of the Canadian Association of Stationary Engineers to say honestly whether any single engineer has been refused admission because he did not know enough. As everybody who applied has been admitted, how comes it that members alone possess the concentrated skill and smartness of the country and no one else possesses any? If your correspondent "Safety" had been at all acquainted with the circumstances of the explosion on Dufferin street he would not have been quite so ready to make an exhibition of himself in condemning a man who probably knows more about an engine than he does with all his assumed virtue. I happened to be present at the little occurrence spoken of, and can give a complete and unqualified denial to the aspersions of "Safety." The boiler in question was in a wood enbuilding surrounded by large quantities of inflammable material in the shape of cut and split wood, slabs, etc. Everything was in perfect order, and the employees were preparing to leave for the night, when the roof was discovered to be on fire. Before word could be sent to the fire hall, the whole building and contents were in flames. The boiler being of the locomotive type and not covered by brickwork, soon began to feel the effects of the heat, and made steam rapidly. The safety valve was blowing furiously, and probably no harm would have been done, when suddenly the heavy beams of the roof fell down across the lever of the safety valve. There could only be one result, the boiler had to go, and it went ; but to say the engineer was to blame, and go into a fine frenzy about incompetence, and so forth, either shows that "Safety" has been writing about something he was ignorant of, or was venting his spleen against an independent man who chooses to "hoe his own row" rather than equalize himself with the "good, bad and indifferent" components of the ring.

With regard to the letter of "S," I and others who have spoken to me about it, regard it as neither more nor less than brutal. It is well that "S" shelters himself under the wing of an initial, or it is probable the men whom he libels would take it out of his hide.

Both the writers I refer to (I say both out of courtesy, because it is evident they are one and the same person), prate about civic interference, and develop a wonderful tenderness for the public. Gentlemen (?), your philanthropy is misplaced ; there is no soft civic snap for you. This town is governed quite enough already. It is taxed and inspected almost to death. Mind your own business, and don't interfere with better men than yourselves, because they don't see fit to join your blackmailing Mafia, or you may find yourselves strung up to the lamp post of public opinion, and your boasted certificates hung up with you.

Mr. Editor, I must apologize for taking up so much of your space, but the gross misrepresentations and animus of the two letters was too evident to pass over in silence.

Yours etc.,

R.

TORONTO BRANCH NO. 1, C. A. S. E.

Editor ELECTRICAL NEWS.

DEAR SIR,—At the last meeting of Toronto Branch No. 1, C. A. S. E., held in Shaftesbury Hall, on Friday, July 10th, the officers elect for the ensuing year were installed by Bro. past president A. M. Wickens, the only change in the list being that owing to the retirement of Bro. W. Reverley, who has removed to Mimico, Bro. Edward Phillips was appointed to succeed him as financial secretary, and Bro. Butter was appointed to succeed Bro. J. Queen as conductor.

After the two newly elected officers had been installed, they were called on to say a few words, which they did, thanking the members of the Association for the honor done them in placing them in positions of trust, and promising to endeavor to fill the positions they had been elected to with credit to themselves and to the best interests of the Association, and to do their utmost to increase the membership and place the Toronto society in a position second to none on this continent.

Bro. A. M. Wickens then called on President A. E. Edkins for a few remarks on entering his second term of office.

Mr. Edkins thanked the members for the honor bestowed upon him, in thus for the second time electing him to fill the highest office in the gift of the Association, and said that when about a year ago he was elected to the office he was conscious of very serious misgivings as to his ability to properly fill the position. He was, however, glad to know that during his year of office he had succeeded in filling the position so satisfactorily. After paying a deserved tribute to the Financial Secretary, he stated that during the past year there had been admitted over twenty new and very desirable members, and particularly requested each member to make an effort during the coming year to materially increase the membership, which was not as large as it should be in a city such as Toronto. If each member would bring in one new member, what a grand showing it would be at the end of the year.

He was glad to know that although at times some of the members got a little heated in the discussions at the meetings, yet they soon cooled down and everybody again became good friends. This was as it should be ; for it could not be expected that all would be of the same opinion. When anything came up concerning the good of the Association as a body, the members could always be depended upon to stand shoulder to shoulder.

So long as this policy was followed, the Association would prosper in the future as in the past.

In conclusion he thanked the officers and members for the excellent support given him during his term of office, and hoped that the same would be accorded him during the term they were about entering upon, assuring them that he would at all times endeavor to do his duty.

Bro. W. Sutton, who was re-elected Treasurer, next made a few remarks, and presented his yearly report, which showed a substantial balance in the bank to the credit of the Association.

Bro. W. Lewis, who was re-elected Vice-President, thanked the members for re-electing him, and said he would continue to try and do his duty.

Bro. W. Blackgrove has held the position of Recording-Secretary for the past three years, and has just been re-elected by acclamation. Bro. Blackgrove makes the best Secretary the Association ever had, and can point with pardonable pride to the fact that during his years of office not one omission or mistake has occurred in the minutes. The Association is studying its own interest by keeping him in the position which he is so well qualified to fill. The office of Recording-Secretary is no sinecure ; there is any amount of work attached to it, but Bro. Blackgrove is a "hustler" (especially when he is running in a 100 yards race for a fine mantel clock).

Bro. C. Mosely was re-elected as Door-Keeper, and will continue to guard the wicket as zealously as in the past.

The Association is looking forward to a year's solid good work, and if it continues to prosper as it has done, it will before long become the leading stationary engineers association in America—and that without becoming part of the U. S. either.

By the way, I hear that some of the marine engineers are grumbling about the Marine Association not being any good. Why don't they join us ? It would do them good. They would find that instead of our boys not being willing to tell anything they know in the Association, there are often two or three trying to get at the black board at once. And yet we are "only stationary engineers, anyway, and don't amount to a great deal," as a marine man said one day. Well, perhaps we don't, but we are in a fair way to 'get there." If a man is an "engineer" (which few of us and in all the word implies), it does not matter whether he is a marine, stationary, or what.

Yours, &c.,

"SAFETY."

STRENGTH OF BOILERS.

THE tendency of the pressure within a steam boiler is to force the material into the shape of a perfect sphere. Experiments have been tried by making models of various shapes of steam boilers of an elastic material, such as rubber, and then pumping air inside so as to produce pressure of any desired amount and noting the effect in altering the shape. By this plan the theoretical calculations have been tested and proved to be correct.

In a cylindrical boiler the ends, if made hemispherical, will require no stays, but if flat, must be stayed in order to enable them to resist the same pressure as the cylindrical part. In a cylindrical boiler of any given diameter, the strain tending to rupture the shell depends upon the diameter and the pressure, and is found by multiplying the pressure and diameter together. In making such calculations, it is absolutely necessary that the same standard of units be used. If the pressure be taken in pounds per square inch, then the diameter must be measured in inches, and it will be found convenient to assume one inch as the length of the strip of the shell, the strain upon which is to be calculated.

Let the shell be sixty inches in diameter, and the pressure one hundred pounds per square inch, what is the strain produced tending to rupture the cylindrical shell? Sixty pounds × one hundred is six thousand pounds. This, however, bears equally on two sides of the shell, tending to break the cylindrical hoop into two equal parts ; hence the strain on each side is three thousand pounds. Had the cylinder been thirty inches diameter instead of sixty, the strain produced by the same pressure would only have been one-half that amount. It is important here to consider what is meant by a pressure of 100 pounds per square inch. It is 100 pounds and the pressure of the atmosphere, or about 115 pounds, but as the pressure of the atmosphere is on the outside as well, it is usually left out of the count.

Experiments are now being made with a steam boiler formed of one shell within the other. Each contains its own supply of water, and has its own safety valve and connections. In the inner one the steam pressure used is 500 pounds per sq. inch, in the outer one it is 200 pounds. By this means the pressure producing strains on the plates of the inner one is reduced to 300 pounds, and as it is smaller in diameter than the outer shell, the total strain on each shell may be made the same.

In the boiler sixty inches diameter 100 pounds pressure as shown on the steam guage was shown to produce a strain of 3,000 pounds on each inch of the length of the shell. What is there to resist this ? The thickness of the plate, or rather the amount of metal left after the rivet holes have been made in it.

In single rivetted seams the strength may be taken at one-half that of the solid plate, and in double rivetted seams at seven-tenths of the solid plate. If the plate be three-eighths of an inch thick and the strength of the plate 60,000 pounds per square inch, then the strength of the double rivetted joint will be $60{,}000 \times \frac{3}{8} \times \frac{7}{10} = 15{,}750$. The strain was found to be 3,000, and the strength to resist it 15,750, or a little more than five times. This is a very common difference and is called the factor of safety. It is common to have in new boilers a factor of safety of 6, or 5 or sometimes 4. The necessity for having such a difference between the strength and the strain arises from imperfections in workmanship, and uncertainty as to the actual strength of the particular plates.

ENGINEERS' PICNIC.

THE C.A.S.E. picnic at Oakville, on July 1st, proved to be an unqualified success. Notwithstanding the fact that in the early morning there was a regular downpour of rain, and a very gloomy outlook for the day, Toronto engineers and their friends turned out about 350 strong. With abundance of provisions and good feeling, all were bound for a good time, and their expectations were fully realized.

The long list of competitions was carried out to the letter. Steam was let on at three o'clock—a very late start—owing to the weather. Owing to the high pressure carried and the fact that the governor worked to a charm, the bottom of the programme was reached without a hitch of any kind.

The first event was a 100 yards race, members only, the prizes for which, a shaving set, a caddy of coffee and a hack saw, were won by Bros. Chillman and Bellington, of Hamilton, and Bro. Hughes, of Toronto, in the order named.

100 yards race, open to all—1st, Dowling, $3 ; 2nd, Agerst, $2.

Running long jump—1st, Bro. Bellington, 1 ton coal ; 2nd, Bro. Chillman, 1 pocket knife ; 3rd. Bro. Butter, knife sharpener.

75 yards, old man's race—1st, Bro. Sutton, engineer's oil set ; 2nd, Bro. Gilchrist, spring mattress ; 3rd, Bro. Carter, Hamilton *Times*, one year.

100 yards boys' race—1st, Finlay, $1 ; 2nd, Boyle, 50 cents.

Tug of war—Hamilton vs. Toronto—Prizes, silver cup and box of cigars, won by Toronto in two straight pulls.

50 yards girls' race—1st, Miss Williams, pair vases ; 2nd, Miss Irving, toilet soap.

Standing high jump—1st, Bellington, rubber coat ; 2nd, Anderson, hat ; 3rd, W. Lewis, knife sharpener.

Smoking race—1st, Bro. Caffrey, Meerchaum pipe ; 2nd, Bro. Tarranto, caddy tobacco ; 3rd, Bro. Wilcox, briar pipe.

Standing broad jump, open to all—1st, Mr. White, ton of coal ; 2nd, Bro. Bain, bag of flour ; 3rd, , knife sharpener.

75 yards race, engineers' wives—1st, Mrs. Bain, silver water pitcher ; 2nd, Mrs. Moseley, silver butter dish ; 3rd, Mrs. Marshall, Hamilton *Times*, one year.

Best waltzers—1st, H. Graham and lady, silver cruet stand ; 2nd, Mr. and Mrs. Witty, lady's fan ; 3rd, Mr. Benwell and lady, pound of tea.

Quarter mile race, members only—1st, Bro. Moseley, household bank, 2nd, Bro. Nichol, copy of S. P. Thompson's "Dynamo Machinery" ; 3rd, Bro. Miller, 40 yards cotton duck.

Putting shot, open to all—1st, J. O'Rieley, ton of coal ; 2nd, W. Brush, box of soap ; 3rd. W. Leith, knife sharpener.

Shoe race—Miss Waterson, 1 pair boots ; 2nd, Miss Fassants, bird cage.

Engineers' young ladies' race—1st, Miss Everett, G. P. clock ; 2nd, Miss Nichol, Hamilton *Spectator*, one year ; 3rd, Miss Fassants, three bottles of pickles.

Judges and starters' race—1st, Mr. Johnson, 1 ton of coal ; 2nd, Bro. Moseley, ½ ton of coal ; 3rd, Mr. Harrison, knife sharpener.

Consolation race—1st, W. Blackgrove, mantel clock ; 2nd, Hamilton, ½ cord of wood ; 3rd, W. Terry, monkey wrench.

The intention was to have had a game of baseball, Hamilton vs. Toronto, but a shower stopped the game at the end of the first innings, with the score in favor of Hamilton.

The wet morning prevented many from attending. As it was, this was the largest gathering of engineers ever got together in Canada. All present expressed themselves as satisfied with the day's outing, and the picnic bids fair to become an annual one.

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EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

OUR SPECIAL NUMBER.

SATISFACTORY progress is attending the arrangements for the publication of the special number of the NEWS on 1st September in connection with the Electrical Convention in Montreal. The number will contain special articles and illustrations of great interest. Judging by the demands of American manufacturing and supply houses for advertising space, and the fact that representatives of some American houses have recently visited Canada in person, the importance of the Canadian market for electrical goods is being properly appreciated across the line, and a determined effort made to secure as much of it as possible. We would like to see Canadian manufacturers and dealers properly represented in our Convention number, and for this reason we point out the fact that those who fail to secure advertising space at once need not complain if a week or two later they should find that all the best positions have gone to their wide-awake American competitors. A word to the wise is sufficient.

THE convention of the N. A. S. E. opens at Omaha, Neb., on the first Tuesday in September. It is expected that at this meeting the question of changing the name and constitution of the Canadian Society for the purpose of making it international will be considered.

WE print in our correspondence column a communication signed "R," having reference to two letters which appeared in our last issue. It may be that "R" shows a little of that intolerance which he so unsparingly condemns in others, but we think that the engineers may find in it at least some food for serious thought.

A SEVERE blow has been struck at the prosperity of the natural gas industry on the Niagara peninsula by the action of the United States Board of General Appraisers in levying a 10 per cent. duty on natural gas generated and exported by the Provincial Natural Gas and Fuel Co. of Ontario to the Natural Gas and Fuel Co., of Buffalo. The company will probably require to turn more of its attention in future to Canadian cities.

THE Federal Telephone Co., of Montreal, has been absorbed by the Bell Telephone Co. The Montreal City Council should now follow in the footsteps of the City Council of Toronto by placing such restrictions upon the Bell company as will insure fair treatment to the citizens. If this is done, the placing of the telephone business in the hands of a single company should prove a source of public satisfaction.

THE yearly meeting of the Executive Board of the C. A. S. E. will be held in Toronto on Tuesday, Sept. 8th. Delegates from all the Associations are expected, and the work of perfecting the organization will engage their attention. The work of the past year will be reviewed, and an effort made to insure greater progress in the future. Engineers throughout Canada should take an interest in these meetings, the object of which is to assist by all legitimate means in raising the status of the business.

IN pursuance of the Engineers' Act, passed at the last session of the Ontario Legislature, the Board of Examiners are nearly ready to examine and grant certificates to engineers. The necessary printing is now in hand, and as soon as completed, the examiners can get to work. Any engineer wishing information on the subject, can obtain it by addressing Mr. J. A. Wills, Custom House, Toronto; A. M. Wickens, *Globe* office, Toronto; or Robt. Dickinson, Electric Light Station, Hamilton. We are informed there are a great many applicants waiting the opportunity to be examined.

THE elaborate, secret, and costly experiments in human butchery that have recently taken place in a New York prison appear to have been more or less successful. Whether "the game is worth the candle," however, is another matter. We are inclined to the belief, previously expressed by us, that it is entirely an unnecessary waste of thunder. A good dose of cyanide or prussic acid would do the business quite as effectively and be wonderfully cheap and inexpensive in comparison. But we also incline to the belief that the old-fashioned rope is quite good enough to perform the happy dispatch for men of such brutal instincts as the subjects recently devoted to the "electrocutioner's" art.

IT is unfortunate that the date set for the convention and exhibition of electrical appliances in Montreal will conflict with that of our own Industrial Exhibition in Toronto. We understand the date of the Montreal convention has been fixed for the 8th, 9th and 10th of September, and for the exhibition there, the 7th to the 16th of the same month. The Toronto Exhibition is billed from the 7th to the 19th of September. As, however, the second week of the Toronto Industrial is usually considered the best, visitors to the convention will be enabled to visit it on their return from Montreal. It will be somewhat more of a task to those who wish to exhibit at both places, but greater difficulties than this have been overcome by enterprising electrical men.

IN order to properly appreciate the advantages conferred by the electric light, it is only necessary that one should spend a night in a town to which this modern illuminant is a stranger. Bracebridge, Muskoka, where the writer landed one night recently, is such a town. An attempt has been made to light the streets by planting coal oil lamps at a few of the principal street corners. It was impossible to observe the results, as on the night in question the lamps remained unlighted in the expectation that the moon would give a more satisfactory light and at less expense to the municipalty. This expectation not being realized, the town was wrapped in Egyptian darkness. Persons unacquainted with the place ventured out at the risk of falling at every step. It was impossible to discern the features of persons one might meet. Altogether, the effect upon those accustomed to move about beneath the penetrating rays of the electric lamp, was gloomy in the extreme. No town of the importance of Bracebridge should be without electric street lighting. It adds wonderfully to the comfort of the citizens, tends to increase population, and maintains the town's reputation for progressiveness. The water-fall at Bracebridge we imagine would provide effective and economical power for the operation of an electric plant. It is the more surprising therefore, that the advantages presented have not been made available.

A CURIOUS illustration of the sensitiveness of modern scientific instruments was afforded some time back in Toronto when it was noted by Prof. Carpmael, at the Observatory, that some of his apparatus was influenced in a remarkable manner at certain

times of the day. On thinking the matter over, he came to the conclusion that it was the current of electricity in the street lighting wires that was the cause, although the nearest wire to the observatory was on Bloor street, nearly a mile away. To prove the matter, he made a note of the times of the influence, which on comparison with the city time schedule for starting the lights, was found to exactly agree. It is now found that similar instruments to Mr. Carpmael's, namely, those for measuring earth currents and magnetic disturbances, located at Greenwich Observatory, near London, have been found to be thrown into vibration by the passing of trains on the Stockwell Electric Railway. The railway tunnel is over two miles from the nearest earthplate connected with the observatory, but the currents set up are sufficiently strong to make very distinct deflections. The times of the interference being exactly the same as those on which the trains are running, leave no doubt as to the cause of the disturbance. Fortunately, Mr. Carpmael says, the cause of the disturbance being known, it can be allowed for without affecting the general results obtained from the instruments.

At the request of a number of managers of electrical companies, the publisher of the ELECTRICAL NEWS recently addressed a circular to the owners of electric plants in Canada asking an expression of their opinion regarding the desirability of organizing a Canadian Electrical Association. They were also requested to state whether they would be willing to attend an informal meeting in Toronto on September 17th to consider the subject. The replies received are almost unanimously in favor of the proposition, and so many have declared their willingness to attend a meeting, that it has been thought well to announce that the meeting will take place in this city on the date mentioned. Particulars as to place of meeting, etc., will be given in the September number of this journal. Meanwhile, every person connected with the electrical interests of the country is urged to be present on the occasion.

If present indications are reliable, and they should be, there is prospect of a great time ahead for electricians and the electric interest generally at the forthcoming convention to be held in Montreal. The date of opening is fixed for the 7th of September, and the citizens of Montreal are even now working with might and main on the details of a royal Canadian welcome which is to be given to the National E. L. Association. There is to be a conversazione arranged for the members; excursions upon and around the mountain; the harbor commissioners will provide a steamboat with the regulation Indian pilot for a run of the Lachine Rapids; the municipal authorities are sparing no pains to do the visitors proud. It may be asked, amidst all these arrangements for the pleasure and entertainment of the visitors, where does the Convention come in? There will no doubt be found a sufficient corner or two to work in the necessary business and instructive features. Not the least among these latter we hear, is to be an illustrated lecture by the famous young electrician, Nikola Tesla, on his recent discoveries in lighting by high frequency alternating currents. This will be a treat to the Canadian electrician such as does not come within his reach every day. In addition to all this, the Electrical Exhibition is expected to be the best ever held in connection with the Association. All the available space has been taken up, and the display of machinery and appliances will be most complete and interesting. We strongly recommend our electrical brethren in Canada to pay a visit to Montreal at some time during the convention and see for themselves how it is done, and be enabled to decide on the advantages of a local association of electric lighting interests, which, while in no sense competing with the wider one of the United States, would be able to conserve the interests of the distinctively Canadian branch of the electric lighting industry.

THE MONTREAL CONVENTION.

A MEETING of the Executive Committee of the N. E. L. A. was held in the Windsor Hotel, Montreal, on Tuesday, July 21st, at which there was present Prof. McLeod, Mr. F. Fairman, Mr. F. R. Redpath, Mr. W. H. Laurie, Mr. John Kennedy, Mr. J. A. U. Beaudry, Prof. Cox, Mr. W. S. McFarlane, Mr. S. C. Stevenson, Mr. J. S. Shearer, Mr. E. C. Arnoldi, Mr. W. E. Christie and others.

Owing to the absence of the chairman it was proposed by Mr. Stevenson that Mr. Kennedy should take the chair. Carried.

The secretary read the minutes of the last meeting, which were adopted.

Mr. Kennedy, as to the arrangement with Harbor Commissioners, reported that the matter was not closed, and further delay was asked. As to the visits to the Canadian Pacific and Grand Trunk railways, he was not prepared to report. Through error it was stated in the newspapers that arrangements had already been made on the invitation of the railways, but nothing of the kind had been done. The Board were to fix that.

Mr. Christie reported that a lacrosse match could be arranged, but the day was wanted to be known that would be suitable. It was also desired to print a programme, the object of which was that once the day was settled for the lacrosse match it would not conflict with the exhibition. A suggestion was made at the same time to draw up a small committee to form a programme.

Mr. Laurie stated that there were several committees already arranged.

The secretary stated that the business aarangements must come first, and the entertainments must be fitted in.

Mr. Kennedy was not in a position to say that it was feasible to carry out the proposal to run the rapids and visit the railway workshops.

Mr. Stevenson suggested that the various sub-committees should report to the General Committee.

Mr. Beaudry asked that the lacrosse match be arranged at once, but it was found impossible to do so.

Mr. Fairman, for the Dominion Bridge Works, stated that a meeting had been held at his office. Messrs. Ives, Cooper and Beaugrand undertook to see the Canadian Pacific and Grand Trunk railways for a guarantee and subscription, and Mr. Ives was to visit St. Francois Xavier and St. James street business people. He could only report progress, and say that they had so far a guarantee amounting to about $1,000.

Mr. Stevenson, for the "Forest and Stream Club," had no definite report to make.

Prof. McLeod, regarding the proposed expenditure in connection with the conversazione, reported having looked over the grounds, and proposed to unite the Molson Hall and the Redpath Museum into one, as the accommodation thus provided would be required. He also proposed to have a large tent and to unite that with the Redpath Museum, the tent being used for refreshments and as an outdoor place where the people could circulate more freely. The size of the tent proposed would be about 120 feet long by 140 feet wide with wings. The canvass required would cost about $150, and carpentry $50 more. It was estimated that the cost of music would be somewhere in the neighborhood of $50. No estimate for refreshments was as yet obtained. He considered that provision should be made for nearly 1,000 guests, and wanted the views of the Committee.

Mr. Christie thought the estimate should be about $400. The secretary stated the amount would probably be about $650.

A motion was made by Prof. McLeod, seconded by Mr. S. C. Stevenson, that Messrs. Beauvais, Carroll and Corriveau be named a committee to draft a programme.

Mr. Kennedy stated that at the last meeting it was suggested not to have too many names on the committees, and the secretary said that a number of the names were not attending, and it might be thought desirable to reduce same.

The secretary stated that a number of gentlemen throughout the city to whom cards were sent had not attended, and it was thought best to strike a number of the names off the sub-committees. A proposal was made to put these names on the general reception committee, which was done, and also that no notices were to be sent to any but the working committee, which was carried.

Mr. Christie desired to know the limit of the Executive Committee, and was informed that it was from 20 to 30.

The exact date of the convention was from the 7th to the 16th September.

A meeting of the Citizens' Executive Committee was held in the Windsor Hotel on the evening of Tuesday, July 28th. There were present Prof. Bovey, in the chair; Messrs. F. R. Redpath, J. Carroll, J. S. Shearer, J. Kennedy, Linnell, Laurie and Toms.

Prof. Cox asked to be relieved from the duties of his position as secretary of the committee, on account of his having been called to England on important business. The resignation was not, however, accepted, but Mr. John Carroll was appointed as joint secretary.

After discussing a variety of subjects connected with the details of the forthcoming convention, the committee adjourned until the 3rd inst.

Subsequently a meeting of the sub-committee on exhibits was held, Mr. F. R. Redpath presiding, when the following resolutions were passed:

"That the secretary be instructed to write to Mr. Dwight, of the Great Northwestern Telegraph Co., regarding pole privileges in connection with those of the Bell Telephone Co., for carrying the wires from McGill University to the Victoria rink."

"That Mr. Corriveau and Mr. Carroll be appointed a committee regarding the decorations for the rink, and report at the next meeting."

A letter was received from Mr. Gulick, president of the Exhibition Committee in New York, reporting that considerable progress had been made in the work of the allotment of space. A number of new applications for space were received. Mr. Carroll was appointed secretary of the sub-committee, in the place of Mr. F. Nicholls, resigned.

A meeting of the Executive Committee is being held in New York to-day (1st inst).

It is the intention of the Montreal press to appoint a committee to receive the visiting pressmen. A meeting to consider the matter will be called at once.

SAFETY VALVES—THEIR HISTORY, ANTECEDENTS, INVENTION AND CALCULATION.

By Barnet le Van.

It will be seen from the above that the weights act at two different points, and that there are three levers to be considered:

First. The long lever L of the weight W, which is the distance from the weight W to the fulcrum *f*.

Second. The lever *x*, due to the weight *w*, of the lever arm *a*, valve *v*, and stem *s*, which is the distance from the centre of gravity *g* to the fulcrum *f*.

Third. The short lever *l*, which is the distance from the fulcrum *f* to the centre of the valve stem *s*.

The centre of gravity *g*, of the lever arm *a*, is found by balancing it over a sharp edge, with the valve *v* and stem *s* attached at the proper distance *g* from the fulcrum *f*. The weight *w* of the lever arm *a*, valve *v*, and stem *s*, multiplied by the distance *x* from the centre of gravity *g* to fulcrum *f*, gives the *momentum*, as before stated, of the lever arm *a*, which is a constant quantity in the graduations of the lever arm *a*, for different pressures of steam.

The form of the lever arm *a* affects the location of the centre of gravity *g*; but when this centre is known, the shape of the lever arm *a* does not affect the static momentums. The area and weight can be expressed in any unit of weight, as well as the levers in any unit of length. For greater accuracy, the centre of the fulcrum *f*, weight W, and valve stem *s*, connections to lever arm *a* should be in straight and horizontal lines; and in finding the centre of gravity *g*, the valve *v* and stem *s* must be in their natural position when the lever arm *a* is balanced over a sharp edge, in order to find the centre of gravity of the system.

The action of the combination is readily understood by the illustration—namely, that the two static momentums, weight *w*, multiplied by the long lever L, added to the momentum *w x* of the lever arm *a*, valve *v*, and stem *s*, multiplied by the distance *x*, from the centre of gravity *g* to fulcrum *f*, act opposite and must be equal to the momentum of the force F of the steam pressure *p*, multiplied by the area A of the valve *v*, and this product by the length of the short lever *l*, or the static momentums. The algebraical expressions of the foregoing may be set up as follows:

$$W\,L + w\,x = A\,p\,l \quad \ldots\ldots 1$$

Or, in words: The area A of the valve *v*, multiplied by the steam pressure *p*, per square inch, and this product by the length of the short lever *l*, equals the weight W, multiplied by the length of the long lever L, plus the weight *w* of the lever arm *a*, valve *v*, and spindle *s*, multiplied by the distance *x* from the fulcrum *f*, to the centre of gravity *g*, or the momentum *w x*, of lever arm *a*. That is to say, the static momentums are in equilibrium.

To find the weight W on a given safety valve when the steam pressure *p* is known, and all the other dimensions known:

$$\text{Weight } W = \frac{A\,p\,l - w\,x}{L} \quad \ldots\ldots 2$$

Rule.—multiply the area A of the valve, in square inches, by the steam pressure *p*, in pounds per square inch, and this product by the length of the short lever *l*, in inches; from this last product subtract the momentum *w x*, of the lever arm *a*; divide this remainder by the length of the long lever L, and the quotient will be the weight W in pounds required.

To find the length of the long lever L, the area A of the valve, the steam pressure *p*, and all the other dimensions being known:

$$\text{Lever } L = \frac{A\,p\,l - w\,x}{W} \quad \ldots\ldots 3$$

Rule.—Subtract the momentum *w x* of the lever arm *a* from the area A of the valve in square inches, multiplied by the steam pressure *p* in pounds per square inch, and this product by the length of the short arm *l*, and divide this remainder by the weight W in pounds; the quotient will be the distance in inches from fulcrum *f* to place the weight W.

To find the pressure *p* per square inch at which a safety valve will blow off, the weight W, and all the other dimensions being known:

$$\text{Pressure } p = \frac{W\,L + w\,x}{A\,l} \quad \ldots\ldots 4$$

Rule.—To the momentum of the lever arm *a*, add the product of the weight W, multiplied by the length of the lever arm L; divide the sum by the product of the area A, multiplied by the length of the short lever *l*, and this quotient will be the steam pressure *p* in pounds per square inch.

To find the area A in square inches, the weight W, and steam pressure *p*, and all the other dimensions being known:

$$\text{Area } A = \frac{W\,L + w\,x}{p\,l} \quad \ldots\ldots 5$$

Rule.—To the momentum *w x*, of the lever arm *a*, add the product of the weight W, multiplied by the length in inches of the lever L; this sum, divided by the product of the steam pressure *p* in pounds per square inch by the length of the short lever *l*, will be the area A in square inches.

To find the weight *w* of the lever arm *a*, valve *v* and stem *s*, the area A in square inches, and steam pressure *p*, and all the other dimensions being known:

$$\text{Weight of lever } w = \frac{A - p\,l - W\,L}{x} \quad \ldots\ldots 6$$

Rule.—Subtract the product of the weight W, multiplied by the length of lever L, from the product of the area A multipl ed by the steam pressure *p*, and this product by the length of the short lever *l*; this remainder, divided by the lever *x*, or distance of the centre of gravity *g* from fulcrum *f*, the quotient will be the weight of lever *a*, and valve *v* and stem *s*.

To find the distance *x* in inches from the centre of gravity *g* to fulcrum *f*, he area A in square inches, of the valve, the steam pressure *p* in pounds per square inch, and all the other dimensions being given:

$$\text{Distance } x = \frac{A\,p\,l - W\,L}{w} \quad \ldots\ldots 7$$

Rule.—Multiply the weight W by the length of the lever L; from this product subtract the product from the area A, multiplied by the steam pressure *p*, and this product by the length of lever *l*; divide the remainder by the weight *w*, of the lever arm *a*, valve *v* and stem *s*.

Having given the levers L. *l*, and *x* the area A ($D^2 \times 0.7854$), steam pressure *p*, and the weight *w*, the weight W is calculated by formula 2.

Example 2.—A safety valve has a diameter of D=2 inches, and the lever to a pressure of steam *p*=80 pounds per square inch, with the following dimensions:

A=area of valve D=2 inches ($2 \times 2 \times 0.7854$) 3.1416 L=long lever in inches 30
l=short lever in inches 4
x=distance of centre of gravity *g* 15
w=weight in pounds of lever arm *a*, valve *v* and stem *s* 6
p=steam pressure per square inch in pounds 80

What will be the weight required?

$$\text{Formula 2: } W = \frac{A\,p\,l - w\,x}{L}$$

$$W = \frac{3.1416 \times 80 \times 4 - 6 \times 15}{30} = 30.5 \text{ pounds.}$$

Example 3.—Suppose a safety valve to be of the following dimensions, at what distance L from the fulcrum *f* must the weight W be placed to carry a steam pressure *p*=50 pounds per square inch?

A=area of valve D=3 inches ($3 \times 3 \times 0.7854$) 7.068
p=steam pressure per square inch in pounds 50
l=short lever in inches 4
w=weight of lever arm *a* valve *v* and stem *s* in pounds 10
x=distance of centre of gravity *g* in inches 18
W=weight in pounds 50

$$\text{Formula 3: } L = \frac{A\,p\,l - w\,x}{W}$$

$$\text{Lever } L = \frac{7.068 \times 50 \times 4 - 10 \times 18}{50} = 22.6 \text{ inches.}$$

Example 4.—A safety valve having the following dimensions, at what pressure *p* per square inch will it blow off?

L=length of long lever in inches 30
l=length of short lever in inches 3
W=weight in pounds 50
w=weight of lever arm *a*, valve *v* and stem *s* 12
x=length from fulcrum *f* to centre of gravity *g*, in inches 15
A=area of valve in square inches 7

$$\text{Formula 4: } p = \frac{W\,L + w\,x}{A\,l}$$

$$\text{Steam pressure } p = \frac{50 \times 30 + 12 \times 15}{7 \times 3} = 80 \text{ pounds.}$$

Example 5.—The following dimensions, and the steam pressure *p* per square inch to be carried, to find the area of valve A?

L=length of long lever in inches 30
l=length of short lever in inches 4
W=weight in pounds 30
w=weight of lever arm *a*, valve *v* and stem *s*, in pounds 12
x=distance from fulcrum *f* to centre of gravity *g*, in inches 10
p=steam pressure in pounds per square inch 40

$$\text{Formula 5: } A = \frac{W\,L + w\,x}{p\,l}$$

$$\text{Area } A = \frac{30 \times 30 + 12 \times 10}{40 \times 4} = 6.375 \text{ square inches.}$$

or about 2⅞ inches in diameter.

Example 6.—A safety valve of the following dimensions, to find the weight of the lever arm *a*, valve *v* and stem *s*, the distance *x* and steam pressure *p* being given.

A=area of valve in square inches 2
p=steam pressure in pounds per square inch 80
L=length of long lever in inches 20
l=length of short lever in inches 1.5
W=weight in pounds 10
x=distance from centre of gravity *g* to fulcrum *f* in inches 10

$$\text{Formula 6: } w = \frac{A\,p\,l - W\,L}{x}$$

$$\text{Weight } w = \frac{2 \times 80 \times 1.5 - 10 \times 20}{10} = 4 \text{ pounds.}$$

Example 7.—A safety valve of known dimensions, given to find the distance *x* from centre of gravity *g* to fulcrum *f*, in inches.

A=area of valve in square inches 20
p=steam pressure in square inches 30
L=length of long lever in inches 40

l=length of short lever in inches 4
W=weight in pounds 50
w=weight of lever arm a, valve v and stem s in pounds 20

$$\text{Formula 7}: x=\frac{A\,p\,l-W\,L}{w}$$

$$\text{Distance } x=\frac{20\times 30\times 4-50\times 40}{20}=20 \text{ inches.}$$

THE GRADUATION OF SAFETY VALVE LEVERS.

For great accuracy in finding the centre of gravity g, the weight of valve v and stem s should be weighed with the lever arm a; and they also should be placed on the lever at their proper distance from fulcrum f when the lever arm a is balanced over a sharp edge. As before stated, the momentum $w\,x$ of the lever is found by multiplying the weight of lever arm a, valve v and stem s by the distance x from the fulcrum f to the centre of gravity g, which is a constant quantity in the graduation of the lever for different pressures of steam.

Example 8.—A safety valve of the following dimensions, the lever to be graduated from 30 to 80 pounds to the square inch.

First find the weight W required for a steam pressure of 80 pounds to the square inch, which number is to be marked on the lever 30 inches from the fulcrum f.

A=area of valve in square inches 3
p=steam pressure in pounds per square inch 80
L=length of long lever in inches 50
l=length of short lever in inches 2
w=weight of lever arm a, valve v and stem s in pounds 4
x=distance from fulcrum f to centre of gravity g in inches 7.5

$$\text{Formula 2}: W=\frac{A\,p\,l-w\,x}{L}$$

$$\text{Weight } W=\frac{3\times 80\times 2-4\times 7.5}{30}=15 \text{ pounds.}$$

The weight W required to balance steam pressure p=80 pounds to be placed on the lever L—30 inches from the fulcrum f.

Now find the long lever L, or at what distance from fulcrum f shall the weight W=15 pounds be placed to balance a steam pressure of p=30 pounds to the square inch.

$$\text{Formula 3}: L=\frac{A\,p\,l-w\,x}{W}$$

$$\text{Distance from fulcrum } f-L=\frac{3\times 30\times 2-4\times 7.5}{L}=10 \text{ inches.}$$

Then measure off this distance L=10 inches on the lever arm a from the fulcrum f, and mark it with the number 30; divide the distance between the first and second positions of the weight into 80—30—50 equal parts, and number them from 30 to 80 consecutively. The lever is thus graduated for the required pressure of steam by 1 pound of difference per square inch.

The following method of calculating the weight area of safety valves is used by Morris, Tasker & Co., incorporated, of Philadelphia, furnished them by the late Robert Briggs (see Fig. 11).

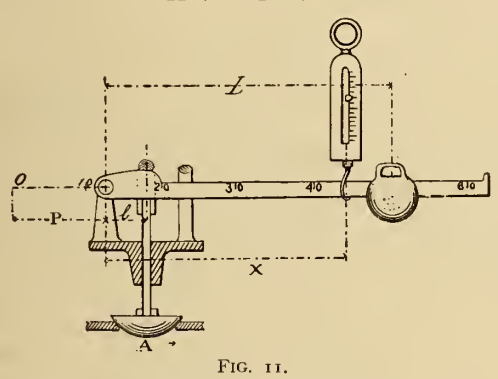


FIG. 11.

First. Multiply the area A of the valve v in square inches (0.7854 D_2) by 10 pounds (or whatever unit of pressure per square inch is taken to form a division of the lever).

Second. Multiply the short lever l, in inches by the area A in square inches and the 10 pounds (the divisions of the lever), which will give 10 A l, which will equal the *momentum* of the pressure on the valve at 10 pounds pressure p, per square inch on the short lever l.

Third. Divide the momentum 10 A l by the weight W, having assumed a weight W which it is desirable to use; the result is the length in inches of each division of the lever which will indicate 10 pounds pressure p on the valve surface.

Fourth. Remove the weight W from the lever arm, hook on a spring balance at some ascertained distance x, in inches from the fulcrum f, and lift the lever arm, valve v and spindle s from its sit by the balance. Take the weight w indicated and multiply it by the distance x, and the result will be the *momentum* of the weight W, and the result will give the length of an imaginary line P, behind the fulcrum f, on the end of which if the weight W were hung it would balance the lever arm, valve v and spindle s.

Fifth. The end of the line P we will call O=zero, as a new point from which the first division commences, and the following divisions are to be carried along the lever arm, as shown on the drawing.

The algebraical expression of the above rule may be set up as follows:
Let O=zero point of lever arm.
L=long lever in inches.
l=short lever in inches.
x=equal distance from fulcrum f at which the spring balance is applied.
W=weight in pounds.
w=weight indicated by spring balance.
A=area of valve v in square inches (0.7854 D_2).

$$\text{Divisions of 10 pounds each}=\frac{10\,A\,l}{W} \quad \ldots 8$$

$$\left.\begin{array}{l}\text{Distance of zero point behind}\\ \text{fulcrum } f\text{, to balance lever}\\ \text{arm, valve } v \text{ and stem } s.\end{array}\right\}=\frac{w\,x}{W} \quad \ldots 9$$

Practically, the pressure a safety valve lever exerts on the valve v can be ascertained by fixing it in its place, and securing the valve and stem in its proper position, and attaching a spring balance to the lever arm immediately over the centre of the valve v. If the weight W be also attached, in lifting the valve slightly the balance will indicate the total pressure which tends to keep the valve in its sit, which pressure being divided by the number of square inches in the valve area A, will give the pressure p per square inch at which steam will commence to blow off.

Example 9.—A safety valve having a diameter of 2.5 inches, its area A

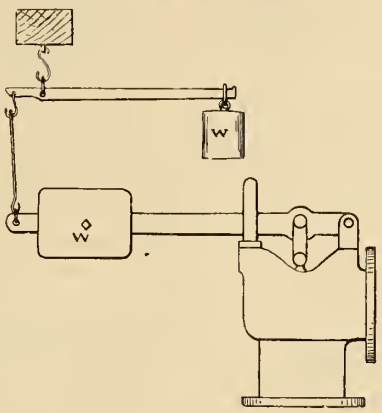


FIG. 12.

will be 4.908 square inches (0.7854×2.5×2.5=4.908). Now, in raising the lever arm a, valve v, stem s and weight W, attached the spring balance indicates 245 pounds, the pressure at which the valve will lift is the quotient arising from dividing this 245 pounds by the area A of the valve—4.908 square inches.

$$p=\frac{245}{4.908}=50 \text{ pounds pressure per square inch.}$$

The pressure exerted by a safety valve lever can be arrived at with a common steelyard as shown in Fig. 12.

SAFETY VALVES WITH BALANCED LEVERS.

Safety-valve levers are sometimes prolonged beyond the fulcrum f, and provided with an adjustable weight W, which is set to balance the weight of the lever arm a, valve v and stem s, as shown in Fig. 13.

This manner of making safety valves simplifies the calculation very much. The algebraical expression of these values may be set up as follows.

$$W\,L=A\,p\,l \quad \ldots 10$$

Rule.—The weight W, multiplied by the length of the long lever L, equals the area A of the valve v, multiplied by the steam pressure p per square inch, and this product by the length of the short lever l.

$$\text{Weight } W=\frac{A\,p\,l}{L} \quad \ldots 11$$

Rule.—Multiply the area A by the steam pressure p, per square inch, and

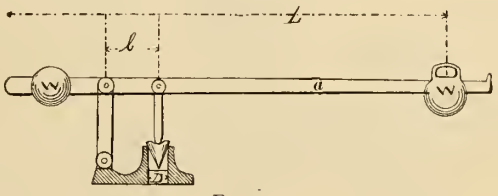


FIG. 13.

this product by the length of the short lever l, and divide this last result by the length of the long lever L; the quotient will be the weight W in pounds.

$$\text{Pressure } p=\frac{W\,L}{A\,l} \quad \ldots 12$$

Rule.—Multiply the weight W by the length of the long lever L, and divide this product by the product of the area A, multiplied by the short lever l; the quotient will be the pressure p per square inch.

$$\text{Lever } L=\frac{A\,p\,l}{W} \quad \ldots 13$$

Rule.—Multiply the area A of the valve v by the pressure p, in pounds per square inch, and this product by the length of the short lever l, and divide this last result by the weight W in pounds; the quotient will be the length of the long lever L.

(To be Continued.)

ACCIDENT PREVENTING DEVICES.

MANY serious accidents occur from motor engines running away when the governor belt slips or slides off its driving pulley. These may be prevented by the duplication of the valve disks, the invention of the writer, and shown in Fig. 1. The ordinary balance governor valve A is provided with two extra disks B B, which do not interfere with the passage of steam to the cylinder when the governor balls are revolving in the proper working plane; but when they fall, by loss of circular motion, the disks B B are drawn into the ways of the steam and effectually stop its flow, whence the engine comes to a standstill.

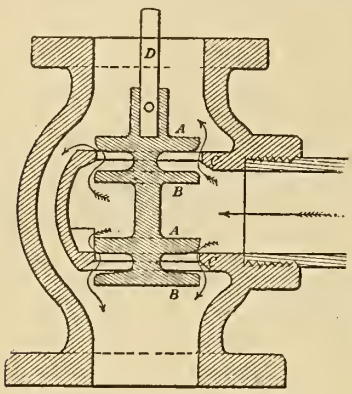


FIG. 1.

Loss of life or limb to an operator very often means the loss of a skilled "hand" to an important industry, as well as the loss to a family of its chief means of support. It may add to the burdens of public institutions, and may lessen the productive power of our mills. Therefore the prevention of accidents, in a humanitarian sense, as well as in a commercial one, should be a matter of deep interest to us, demanding the exercise of ingenuity in the devising of effective means for securing this end.

The subject is a broad one and this paper proposes to merely touch at a few points, and there leave it to the humanely wise to whom a hint is sufficient.

On the well recognized principle that self-preservation is the first law of nature, the duty of establishing and maintaining protective appliances whenever necessary about dangerous machinery becomes apparent, and the effort to do so is worthy of praise, since we find that nature has well considered this necessity, having organized in our being ample means and methods of giving warning of approaching danger, and of guarding us against injury, which are at once effective and beneficient.

Almost every machine has places about it that will pinch the flesh, mash a finger, or crush a bone, and it will perform these cruel acts upon any one who thrusts his members into its open jaws.

With the exercise of ingenuity and care for protecting the machine against injury to itself, the attendant may be protected also, and if proper safeguards be thrown around a machine, such that, with ordinary care and with instructions that may be given, the attendant can perform all the work necessary about and with the machine with perfect safety to himself, thus preserving machine and man, while the employer, who may be held responsible for accidents occurring from exposed machinery, which might have been protected at little cost, will have performed his whole duty.

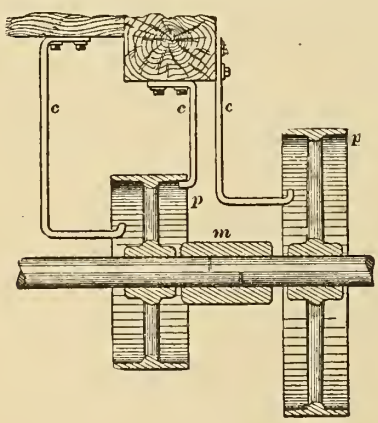


FIG. 2.

A great number of accidents are caused through loss of presence of mind by the eagerness of work people to get through their work expeditiously, under threat of punishment if they do not. The largest contributions to the list of accidents are amputations and maiming of dexter hands, due to this eagerness. If urging must be done, these results of experience call loudly for safeguards and warning mechanism, and the enforcement of stringent rules for safety, which shall be binding alike on employers, on foremen, as well as on the hands themselves.

To prevent accidents happening from belts winding around shafts or couplings of the same, simple and cheap hooks or belt-rests may be devised for and attached in the needed places. They may be located at C, Fig. 2, to prevent a belt from sliding off the pulley, and others at CC, to hold the belt in safe position when off.

In the belt carriers of Mr. Biedermann, which are formed of a bent, flat, iron bow, C, Figs. 3 and 4, generally concentric with the rim of the pulley and around, say four-fifths of its diameter, and carry four to six hook bolts, which project in a circle a few

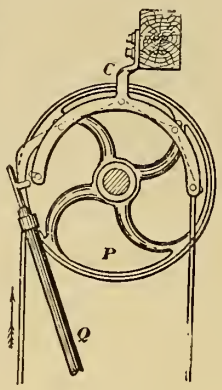


FIG. 3.

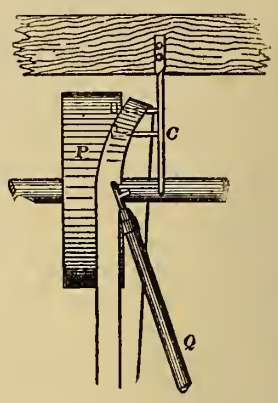


FIG. 4.

inches less than the pulley rim, the first bolt being situated at a point where the belt is taken up, and the last where it is paid out. When the belt is dismounted it is supported by these bolts, retaining a curved position, and is ready to be remounted; it is enough to lift it gently with the long arm Q, surmounted by a curved finger, and bring it in contact with the pulley, when it is immediately carried away on the pulley P without the least exertion.

In the case of a horizzontal belt, which is taken up at the top first bolt may be brought as close as possible to the rim of the of the pulley, the appliance is fitted rather higher, so that the pulley; this bolt being removed from a to a, to allow the long arm to guide the belt and to set it on its real position on the pulley (see Fig. 5). F is a light fork of hard wood, which pre-

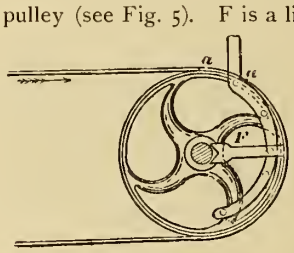
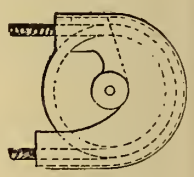
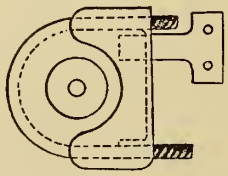


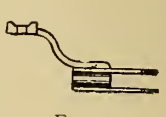
FIG. 5.


FIG. 6.


FIG. 7.

vents the appliance from being bent against the shaft when the belt happens to repose upon it. This fork does not touch the shaft when the belt is on the pulley. When the belt is horizontal, and taken up from underneath, the same kind of appliance is used, but in a reverse manner. Oblique belts, whose angle does not exceed 45°, may retain the appliance in its concentric form, but when it exceeds 45° the form adopted for horizontal belts should be used. Workingmen frequently indulge in the bad habit of taking both ends of a belt (which is off the pulley and resting on a running shaft) in one hand, and of pressing them together, in which case a fold is apt to be formed on the slack part, which is liable to be drawn in under the tight part, and the whole be rolled up rapidly on itself on the shaft, with


FIG. 8.


FIG. 9.

risk of accident to anyone who may get caught in its drawing up folds.

Many accidents occur from ropes and chains running off their sheaves; an idea is given in Figs. 6, 7, 8 and 9 of guards applied to such sheaves. These may be modified in a multitude of ways, according to the purpose to be served, whether as a protection to the hand, where the rope must be taken hold of, or as a safety device to the machine itself, for hoists, cranes, and the like, where dislodged ropes would wreck the machine.

To prevent rolling wheels from running over any obstruction

* Extract from a paper presented by John H. Cooper at the Richmond Meeting of Mechanical Engineers.

in their way, a rail guard, shown by Figs. 10, 11 and 12, is provided and attached.

Devices such as these for preventing accidents to machines and their attendants might be reproduced almost indefinitely.

As new "hands" are coming into the mills all the time, who are presumably ignorant of the dangers surrounding them, and of the constant care which is necessary to be exercised over

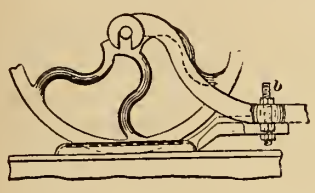


FIG. 10.

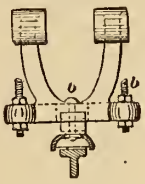


FIG. 11.

persons at all times, and who may meet with accident from such causes, it is desirable to have plainly posted rules, which, if enforced, might enable them to avoid injury.

A rule forbidding the cleaning of shafts and wheels while in motion, with "waste" or rags taken in hand, would save many of these all important members from mutilation or loss.

Stringent, clearly understood rules in regard to starting the motive engine, which should be done only on well determined signals, in cases where repairs are going on in any part of the mill, that no accident may occur to the men at work upon standing machinery; and conversely, plainly visible and easily accessible alarm apparatus should be located at proper places in all the work rooms, which are to be used in cases of accident for signaling the engineer to stop the motive engine at once.

Much has already been done, but much yet remains to substantially protect the attendant against projecting wedges, keys, set screws, nuts, grooves, and the like, of machinery in motion, which are so liable to catch his clothing and scarify his flesh. Many serious accidents have happened from this source, and the exercise of common ingenuity, with uncommon vigilance, seems necessary to reduce their number.

The usual method of protective boxing to belts, ropes, shafts and pulleys, where they pass through floors, should receive attention as their importance demands, and there are peculiar cases of these parts of transmitting machinery that need critical looking after.

The engineer on duty must not be permitted to wear garments with loose, fluttering ends; the same advice may be extended to all attendants, male and female, and to workmen on machine tools or any rapidly going machines.

The subject is an important one, not only in its humanitarian aspects, but in its promotion of increased production, by insuring full confidence to every operative that there is no such thing as harm in any machine, and that accident to man and machine are alike nearest the impossible.

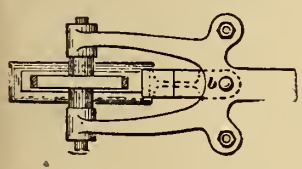


FIG. 12.

Much may be said of the grandeur of our industrial systems and machinery, of the excellence of our contrivances, which will do almost everything except think and talk, yet with their development and use comes a long list of distressing accidents, apparently beyond our power to prevent.

Let us hope that from another presentation of this subject a thought will be added to the many with which the engineer has to deal, and that he will employ it for the safety of the machines and of men; that the growing intelligence of workingmen will lead them into habits of greater watchfulness while in places of danger, and to a more prompt obedience to orders respecting the care of machines, as well as of themselves; and that masters will take a "holding turn" in the consideration and application of protective devices wherever necessary.

QUESTIONS AND ANSWERS.

"A SUBSCRIBER," Brantford, Ont., writes: Will you kindly answer the following questions in the next issue of your journal. 1st. Does the fly wheel increase the working power of an engine? 2nd. Will a drive wheel have the same effect on the engine as an idle fly wheel of equal weight and diameter?

ANS.—(1) A fly wheel, no matter what its weight, does not increase the power of an engine. Its use is to store up the energy imparted to it by the piston at each stroke, and give out that power when the cranks are on the centre and receiving no impulse from the piston. In other words, to produce a uniform motion of the driving power. (2) The drive wheel of equal weight and diameter will have exactly the same effect on the engine as a separate fly wheel.

BOWMAN & ZINKAN, Southampton, Ont., write: Last week we had a very heavy thunder storm, and it seemed to affect our dynamo and circuits to some extent; and in one of our neighboring towns we understand an arc lamp placed in one of the stores was smashed while the dynamo was in operation, and it is supposed it was caused through the effects of the lightning. Would you kindly let us know through the columns of the ELECTRICAL NEWS what effect a heavy thunder storm is likely to have on a dynamo and circuit if in operation, and what precaution can be taken.

ANS.—The effect of an atmospheric discharge known as a static spark or lightning may be disastrous to a dynamo in a number of ways. If the dynamo is not in operation, as a rule no harm is done, the atmospheric spark simply taking the nearest path to complete a circuit or to pass to ground. If in operation, the current of the dynamo is liable to follow the spark and make a short circuit in the dynamo, either perforating the insulating of the field magnets or the armature, or burning out the insulation of the brush holders. All dynamos connected with outside aerial circuits should be protected by some approved form of lightning arrester to conduct the atmospheric discharge to ground, preferably self-acting, constructed to open the ground circuit in case the dynamo current followed the spark to ground. Most makers of dynamos furnish lightning arresters to go with their system.

G. W. writes: I have just had a patch about one foot diameter put on one of my boilers. The patch is 5-16 steel, single rivetted. What pressure can I safely put on it? The boiler is 4 ft. x 12 ft., with 70 three inch tubes in it, thick and double rivetted on the longitudinal seams.

ANS.—The formula reads thus:

$$\text{S. W. P.} = \frac{\text{s} \times \text{t}}{\text{d} \times \frac{1}{2}}$$

S. W. P. means safe working pressure, or the strength multiplied by the thickness, divided by half the diameter in inches, equals what the boiler is safe to work at. Steel 1 inch square has a tensile strength of 60,000 lbs. One-fifth of that is the S. W. P. or strain; or, $60{,}000 \div 5 = 12{,}000$ lbs. $12{,}000 \times 5\text{-}16 = 3{,}750$ safe working strain of solid plate. Your patch being single rivetted, the strength has been reduced from .75 to .56 (.75 is the strength of double rivetted seams). $3750 \times .56 = 2100$ safe working strain of patch. $2100 \div 24$ inches $= 87.5$ or $87\frac{1}{2}$ lbs. is the S. W. P. of your boiler.

A. S., Toronto, writes: Can you tell me an easy way of setting Corliss valves and cut off gear to be pretty near correct? My engine is a 13 x 30, running 75 revolutions per minute, with about 80 lbs. pressure as a rule.

ANS.—First roll the engine round in the same direction it runs every day until the rock-arm stands perpendicular (never mind where the crank is now), then take off the back bonnets on the ends of the valves. If you inspect the valves very closely you will see a slight file mark on them; these file marks are the outside edges of the valves. If you look again very closely, you will also see other file marks, one on the outside of each valve seat or steam port; the marks are below the steam valves and above the exhaust valves for the steam ports. Set the steam valves, the two on the top of the cylinder, taking the valve nearest to the cylinder head first, by placing the file mark on the valve $\frac{3}{8}$ of an inch past the file mark on the valve seat—that is, the mark on the *valve* must be $\frac{3}{8}$ of an inch nearer to the cylinder head than the mark on the seat. Now take the valve on the other end of the cylinder and set the file mark on that one $\frac{3}{8}$ of an inch past the file mark on the valve seat; that is, the mark on the *valve* must be $\frac{3}{8}$ of an inch nearer to the crank end of the engine than the mark on the seat. Next set the exhaust valves, taking the one nearest to the cylinder head first, by placing the file mark on the valve $\frac{1}{8}$ inch past the file mark on the seat *in the same direction* as the steam valve over it. Take the other exhaust valve on the opposite end, and set the file mark on the valve $\frac{1}{8}$ of an inch past the file mark on the seat in the same direction as the steam valve above it. To set them with accuracy you will have to loosen the arms that work the valves, and shorten or lengthen them according to the way the valves should go. The valves are now set as far as the lap is concerned. You will now get the lead on them. Roll the engine the direction she works until she comes to a dead centre; it does not matter which centre you take first. Loosen the set screws in the eccentric, and put somebody on it with a wrench whilst you go back to watch the valves move. Let the man on the eccentric pull it forward in the same direction that the engine runs until the file mark on the valve gets 3-32 of an inch inside the file mark on the seat (just the opposite way to getting the lap). If the valve is already more than 3-32, push the eccentric back till it is right, and fasten it there, then roll the engine forward again to the next centre, and you will probably find that the file mark on the other valve is already inside the mark on the seat. If it is not quite the same as the other valve, divide the distance you moved the eccentric between the two valves. In giving the lead on the valves when cold, get all you can of the 3-32, as the valves when hot will expand and thus decrease the lead. Having thus set the valves, next get the cut-off. Start up the engine slowly until it begins to cut-off; watch closely the travel of the shoe on the guides, or the position of the crank. If the shoe travels farther on the guides on one stroke than on the other, the cut-off rod on that stroke wants shortening. Suppose it travels a few inches farther when leaving the cylinder head than when coming back again, shorten the long cut-off rod, or shorten the short cut-off rod if it cuts off too far when coming in from the crank end. If these directions are followed closely your engine will be set about as true as you can ever get it without an indicator. By using an indicator you will get the valves set closer than by following all the written instructions in the world.

NOTES ON THE DESIGN OF MULTIPOLAR DYNAMOS.*

5.—RELATION OF AIR-GAP TO DIAMETER OF ARMATURE AND NUMBER OF POLES IN DIRECT CURRENT MACHINES.

HAVING established the proportionality of the volume and diameter, it is easy to find the relation which must exist between the diameter and length of air-gap for any particular angle of embrace in order that sparking may not occur. I need not take up time ringing changes on the several equations, as to obtain the relation now referred to, all that has to be done is to substitute for v in (1) its value in terms of the diameter accordingly, as the winding is of the cylinder or drum type, and find the connection between l and d. Preserving the same safety factor throughout, it will be found that two-pole dynamos with a mean gap induction of 5,000 C. G. S. units per square centimetre, and pole-pieces embracing an angle of 130 deg., must have—the volume being related to the diameter as described—a gap of not less than

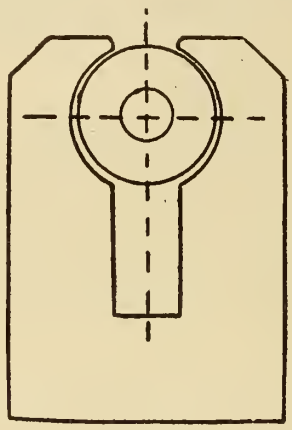


FIG. 3.

.036 d if cylinder-wound, or .054 d if drum-wound. As will have been observed, the air-gap may diminish as the induction is increased, or as the volume is reduced.

But, as is also seen from the equation, the gap required for any particular volume is proportional to the angle of embrace, and if we substitute for two poles a greater number of correspondingly less angular width, working with an increased diameter and volume without a proportionally increased gap is made possible. This is where the advantage of the four, six, or even eight-pole machine comes in. Keeping to two poles, increasing the diameter requires either a proportional increase in the gap, whether the space is required for the conductors and clearance or not, or an increased induction, or a diminished polar angle, or a combination of these. In either case, the magnetizing force spent in the gap is increased; and, other things remaining the same, obviously it would be of some advantage to adopt a construction which, while producing no greater tendency to sparking, would admit of the air-gap being reduced until its length was just sufficient to accommodate the conductors and allow of the necessary clearence. The workdone by an armature of given external dimensions we have seen to be quite independent of the number of poles, and the choice of this number can only be a question, therefore, of structural and working economy.

6.—DIMENSIONS OF THE ARMATURE

It has been observed that the output of an armature is proportional to d^2 L ; and the induction being the same, the weight of the core for a given number of poles must be proportional to the output, the radial depth increasing directly as the diameter, so that a proportionally increased field may be carried. The number of poles being fixed, the weight of the core for a given output may be taken, therefore, as approximately constant, whatever the ratio of L to d.

As the number of poles isincreased, the induction remaining the same, the radial depth of the core is diminished in proportion, and, within the limits of practice, we make the further assumption that theweight is inversely as the number of poles. The money value of a reduction in the weight of material due to increasing poles can easily be arrived at.

The power wasted in hysteresis is proportional to the weight of iron magnetized, and to number of reversals per second. The weight being inversely, and the reversals directly, as the number of poles, the power wasted is for a given out-put the same; furthermore, as the output is proportional to the speed, we may say that for a given induction to the loss in hysteresis is about proportional to the output only, without reference to speed of rotation, weight of core, or number of poles. If it be more important to reduce the loss by hysteresis than to reduce the weight of material, it can, of course, be done. It is a point for the designer to consider.

So much for the core; let us now consider the copper part. Taking Gramme-wound armatures having an interior opening equal to .66, or two-thirds of the core-diameter, it is found—the output, speed, and temperature being predetermined—that the ratio from L to d may vary through a considerable range without making any great difference in the weight of copper or efficiency. For instance, the most efficient relation being $L=\frac{d}{3}$, it may be varied on the one hand till $L=d$, or on the other till $L=\frac{d}{6}$, without increasing the copper by more than about 10 per cent. Of course the watts wasted in the armature are correspondingly increased, but within the limits of the large variation mentioned the reduction in the electrical efficiency of the machine is under one-half per cent. In two-pole machines L varies from .5 to 1.5 d, the normal relation being about $L=d$. As has been seen, the gap has to be increased in proportion to the diameter, unless a greater number of poles be employed; and the disadvantage of an increased magnetizing force would, in machines with only two poles, counterbalance the slight advantage of getting the armature dimensions nearer the best proportion. When the poles are increased, however, the gap may remain fixed, and if the radial depth of the core be correspondingly diminished, the proportions for least copper and highest efficiency are altered : thus, in a four-pole Gramme we can work from $L=\frac{d}{3}$ up to $L=\frac{d}{12}$ without a greater variation than 10 per cent. in the weight of copper. Observe, this is a question differing altogether from the one which was considered in my former paper. In that case the length and radial depth of the armature over the winding were fixed, the problem then being to find the best relation of copper to iron. Here both radial depth and length of core alter, also the peripheral velocity, though the revolutions per minute remain the same. Why the velocity is allowed to alter will be immediately apparent; I only show at the moment that the dimensions of the armature may have their relations altered considerably without making any considerable difference to the weight of copper or efficiency.

To drum wound armatures precisely the same reasoning applies. Here, speed and temperature being fixed as before, the best proportion for two-pole machines is about $L=3.3\,d$; but

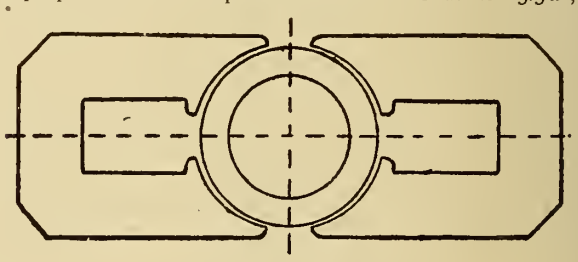


FIG. 4.

because of the distance between the bearings which such a relation would necessitate being inconveniently great, we rarely find $L=2\,d$ exceeded. The latter requires about 5 per cent. more copper than the former ; while for the usual proportion, $L=1.5\,d$, 12½ per cent. more is required than for $L=3.3\,d$. The variation which can be made without over-stepping the limits of economy has a smaller range in drum than in cylinder machines, owing to the greater relative importance of the end wires, because of their greater length. If the length of the core is reduced below $L=1.5\,d$, the copper in machines with two-poles increases rapidly ; but if the number of poles be increased, the length of the end wires being shortened nearly in proportion, the core length may be reduced to a fraction of the diameter without sacrifice of copper or efficiency. In a four-pole machine, for instance, the same copper is used with $L=.5\,d$, as in a two-pole one with $L=2d$; while for six poles, without increasing the copper, the relation may be as small as $L=.25\,d$. The effect of adding poles when the diameter is relatively great is not so

* Paper read by W. B. Esson before the Institute of Electrical Engineers, London, April 9, 1891.

noticeable in Gramme-wound machines, as the end wires are less important.

All the above facts go to prove that if there is anything to be gained, as regards the production of the field, by increasing the daimeter of the armature and the number of poles, there is nothing, considering the armature by itself, to be lost by it. It may in fact, be rather an advantage, because the weight of iron core is reduced. It is true the peripheral velocity is increased; but this does not matter in the least, provided a certain limit is not

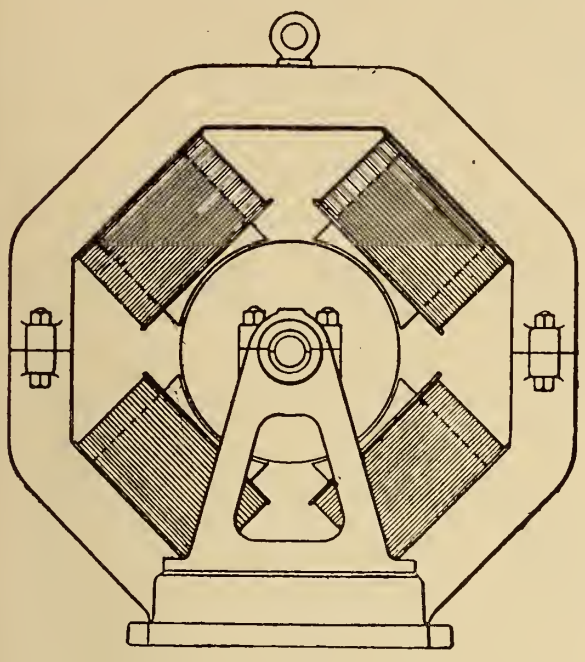


FIG. 5.

exceeded. Opinions differ as to what the limit should be, some machines working at 50 feet per second, others at 100, and a few as high as 125. But there is no reason whatever why any properly constructed armature should not run at a periphery speed of 100 feet per second; and provided this velocity is not exceeded, any advantage which may be obtained by a relatively large armature and increased number of poles should be secured.

7.—DIMENSIONS OF THE FIELD MAGNETS.

It will be apparent, from the foregoing considerations, that the employment of two, or more than two, poles for direct-current machines of moderate dimensions resolves itself mainly into a deliberation regarding the most economical shape to give to the field magnets. As regards the armature, considered by itself we may say that the choice of dimensions is mostly a matter of convenience, seeing that the amount of copper required and efficiency are for a given output practically unaltered by variations in this respect, while the reduction in the weight of the core due to an increased number of poles is to some extent compensated by the extra expense of larger plates and increased weight of the armature supports. Again, the cost of the labor is increased by the larger diameter; but, everything being taken into account, considerations respecting the armature do not influence the design to a very great extent. One thing in favour of increasing the poles, as far as the armature is concerned, must, however, be remembered, and that is the reduction, consequent on a smaller conductor being used, of the losses arising from parasitic currents. We now turn our attention to the magnets.

I have said that for the prevention of sparking it is necessary, that, the induction per square centimetre remaining the same, the air gap increases proportionally to the diameter, whether the space is necessary for conductors and clearance or not, but that the coefficient by which the diameter has to be multiplied to give the length of the gap necessary to prevent sparking, diminishes directly as the pole angle. In comparing the magnet system of a four or six-pole machine with that of a two-pole one, it is necessary to adopt dimensions for the armature in accordance with the considerations already mentioned; hence, if the two-pole armature had a length of core equal to one and a half times its diameter, in a four-pole one the length should be about half the diameter. The diagrams (Figs 3 and 4) show the cross sections of two such machines. The diameter of the four-pole armature is 1.4, and its length .5 times that of the two-pole one, consequently both machines give the same output. The weight of the two horse-shoe magnets in the four-pole machine come to 56 per cent. of the weight of the single horse-shoe magnet, which indicates in this particular case a considerable saving in wrought iron. In taking the copper weight it is necessary to bear in mind that this does not vary simply as the length of the wire if the machines are of the same efficiency, but as the square of the length; so in this particular comparison the copper on the two horse-shoes would be, roughly, 30 per cent. more than on the single horse-shoe, assuming the length of the air-gaps to be the same. Now, if it were possible to reduce the gaps by 12 per cent. or so, the copper weight would be similar in both machines, and we should have credit for a certain amount of iron saved in the construction of the four-pole one, which could be balanced against the increased expenditure for labor. If the gap can be be reduced by more than 12 per cent.—always retaining the depth of the winding the same—there is a saving of copper as well as iron, and it is simply the comparison between the value of the copper and other materials used and the cost of the labor in the two cases which determines, least in machines of moderate size, whether two or more poles should be adopted.

In getting out the best relation of L to d in the different types of armatures, it is assumed, of course, that, the volume being proportional to the diameter, the depth of the winding remains unaltered, as that is the condition which gives uniform rise in temperature. Accordingly, for a given output, the layer of copper on the armature will be of the same depth whether the machine has two poles and an armature having a length of only half the diameter. But whether it is possible to reduce the gap to an extent which, with an increased number of poles, will lead to a less costly construction, is a question which for machines of moderate dimensions must receive careful consideration in each individual case. The answer depends upon how much larger the gap has to be to prevent sparking in the case of two poles only, than is requisite to accommodate the conducto rsand allow the necessary clearance. If the difference is considerable, it may pay better to add poles, and reduce the gaps that way, than to do the same thing by diminishing the pole angle or increasing the induction, or both. The question, it appears, is answered in different ways by different people. It is somewhat interesting to note, for instance, that one engineer, distinguished for the past six years as an ardent advocate of multipolar machines, has,

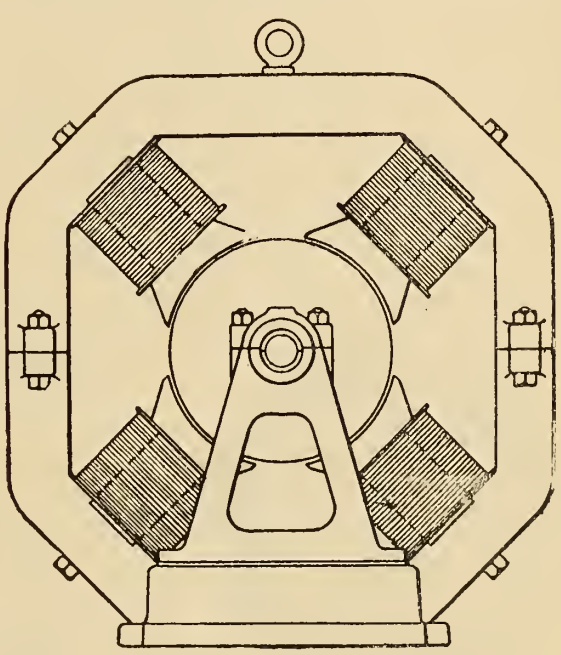


FIG. 6.

after reducing from six poles to four, lately arrived at two, while another has jumped straight away from two to six without a halt at the intermediate number.

But when we come to machines of a certain size there is undoubtedly a gain in employing more than two poles only. Consider the case of a two pole armature of 60 centimetres diameter. Assuming the induction in the gap to be 5,000 C. G. S. lines per square centimetre, and the pole angle 130 degrees,

our calculations show that the length of air-gap would require to be 3. 24 centimetres. This is some 40 per cent. in excess of the requirements of conductors and clearance ; so, if the gap is reduced until it just allows of the requisite clearance, the induction must be increased from 5,000 to 7,000. Keeping the output of the machine the same, however, we can reduce the diameter of the armature to 54 centimetres, and work with an induction in the gap of 6,500. Observe, the magnetizing force spent in the gap has now been reduced by about 7 per cent., but the total field through the armature has been increased by 15 per cent., and the induction in the armature per square centimetre by more than 25 per cent. If we retain the same section of iron in the fields, it may be assumed then that about the same total magnetizing force is required, whether the machine has an armature 60 centimetres diameter, with a gap induction of 5,000 C. G. S. units, or one 54 centimetres diameter, with a gap induction of 6,500. The latter might turn out to be impossible owing to the greater heating of the armature core ; anyway, what I am attempting to show now is, that by pressing up the induction with a view of reducing the gap, little if any, advantage is obtained. But by increasing the number of poles, and reducing the gap in that way, we effect, without increasing the gap induction, a marked economy. As it is unnecessary to go into a mass of figures to prove what each can readily prove for himself from the data already before you, I will just give here the results. If we substitute for the two-pole armature of 60 or 54 centimetres diameter and 90 centimetres long a four-pole one of 84 centimetres diameter and 45 centimetres long, a gap induction of 5,000, we require for the magnetizing coils while working at the same speaking limit, and with the same efficiency, rather under 70 per cent. of the copper on the two-pole field. When to the saving in copper there is added the saving in iron, there will be, after the extra labor is debited against the four-pole machine, a considerable balance in its favour. But to go beyond four poles in this case would be a mistake. Increasing the poles always results in actual increase of copper, unless at the same time the power spent in the gap is reduced, and this latter must be effected without reducing the thickness of the armature winding. The economy shown above is simply due to the fact that, in a two-pole machine of the dimensions specified, the gap necessary for the prevention of sparking must be much larger than the conductors require unless pressed up to a high induction. If with four poles the gap is still larger than necessary, we go to six poles, and so on. But when we arrive at a point where increasing the number admits of no reduction in the gap, we go no farther. It may be mentioned, however, that even in sizes where a four-pole construction showed no actual economy in first cost, it might still be preferable to the two-pole on account of its symmetrical field and the absence of the magnet pull.

(To be Continued.)

Mr. F. J. Barkey, is about to introduce incandescent electric lighting to the citizens of Tilsonburg, Ont., having recently purchased a 300 light dynamo for the purpose.

WAYSIDE NOTES.

(By a Travelling Correspondent.)

The town of Petrolia is very poorly lighted, the townspeople being afraid of adopting more generally the electric light lest it might injure their refined oil trade.

Brooks' Peterborough carbons now seem to be meeting with favor, and the electricians who have tried their last effort say they are equal to the carbons made on the other side.

Oil Springs, where there are about 50 steam plants working the different wells, might digest some of the remarks applying to Petrolia. The engineers of Messrs. Fairbanks keep their several plants in a very clean condition. The working of the engines is conspicuous by the absence of "pounding" so general in many of the plants both here and in Petrolia. If the other owners would only get their "rigs" in the same condition, the improvement would soon pay for itself.

The town of Strathroy has in Mr. S. N. Saylor a townsman who ought to have their support and thanks. Entirely at his own expense he has installed an electric light plant, consisting of a 50 h. p. Wheelock engine and a 4 and 8 ampere dynamo 1,000 and 2,000 lights. The town and stores have 30 arc and 5 incandescent lights. Still, the fact is to be regretted that the storekeepers and hotels do not more generally adopt the light. Possibly if the town had'nt it, they would lament the want of it.

The Forest City (London, Ont.) Electric Light Co., which is owned by Messrs. Hunt Bros., are seeking incorporation. The plant consists of two engines, 210 h. p., and a water power of 125 h. p., operating four 40 light, one 20 light and one 10 light Royal dynamos. This Company supply eighty-five arc lights 2,000 c.p., and ten incandescent to the city, and fifty-five arc lights to private users. The plant is under the able supervision of Mr. Robt. A. Lyons, with Mr. Richard Shapland as engineer and assistant.

Petrolia being the seat of the Canadian oil supply for lubricating purposes, may have an interest to our engineer readers. I visited a great number of the oil wells, also the whole of the refineries. The crude oil is forced by a Jerker pump from the rock. Some of our readers may not have seen the "Jerker"; I will explain. The "Jerker" is a wheel laid horizontally, and is worked from the engine by two shafts at each point of its diameter. The shafts work alternately, consequently giving the Jerker motion. From this wheel are attached lines to the pumps at the wells, and by this method as many as 150 wells are pumped by the one engine. At the refineries the crude is distilled and the different oils given off and afterwards manufactured into the cylinder and machinery oils. Some of the boilers here are in such a state that perhaps many of the engineers in our cities would be afraid to run them, the water being very hard and the boilers consequently scaly. I saw three of them opened, and the scale was of a thickness varying from ¼ to ½ inch. Some of of the boilers are run night and day, two men to each "rig," working twelve hours per day each. Don't you think these hours are too many? I do! But there is no help for it—"If you don't like it, you can leave it; lots of men (not engineers) to take your job." The well owners seem to have been very much afraid of the original Engineers' Bill becoming law lest they would have to employ competent men. One of them even went so far as to send a petition against the Bill to the member representing his constituency. It was signed by himself, and the words "and others" added thereafter. Quite a numerously (?) signed petition, eh! There are plenty of good engineers in Petrolia, and lots of material to make more. The men have never had a chance of improving themselves, and have (owing to their long hours), never had inclination or encouragement to do so. There are over 400 steam plants in this oil territory, and out of this number I got only about 50 subscribers. This number is the smallest average by 75 per cent. in the whole of the cities and towns canvassed. This ought not to be. It is to be hoped for the credit of the engineers themselves in the Petrolia oil territory that they will not be behind the engineers in other towns and cities in recognizing in your journal a means of improving their intellectual and financial standing.

I thank those engineers of Petrolia who so kindly let me their assistance in getting subscribers ; also for their information respecting their different plants.



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Chief Engineer Toronto Water Works.



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The first transformer was constructed by Faraday in 1831.

Arrangements will shortly be made to light the town of Athens, Ont., with electricty.

The wires are being laid which are to operate the electric railway at St. John, N. B.

All the necessary arrangements have been made for the transmission of power to operate the electric apparatus at the Montreal exhibition.

Messrs. Guillaume & Felton, manufacturers of electrical wires and cables, Germany, have cabled for space at the coming Montreal electrical exhibition.

Mr. Allen, of Gloucester street, Ottawa, has invented an electric light hanger, for the patent of which he is said to have had some good offers.

Mr. D. Thomson has succeeded Mr. Clarke as manager of the Hamilton Electric Light and Power Co. It is rumored that Mr. Clarke will represent the Brush Co.'s interests in Canada.

Negotiations are said to be in progress for the purchase and reorganization by a syndicate of the Sarnia Gas Co., the intention being to increase the stock to $100,000, and introduce the electric light.

The Fort Wayne Electric Co., through its Canadian agents, Mr. W. J. Morrison, Toronto, and Mr. A. J. Corriveau, Montreal, has signified its intention of presenting to McGill University, Montreal, a valuable electric light plant.

The important fact is announced that the London Edison Light, Heat and Power Co. has been organized to introduce an underground electric light (incandescent) and power system at London, Ont. Toronto capitalists are said to own one-third of the capital stock, which amounts to $75,000.

The recently completed telephone line between London and Paris has two complete circuits, so that if an accident happens to one the other is available. A strand of copper weighing 160 pounds per mile composes each conductor, while each strand is covered with alternate layers of a composition and gutta percha. The four conductors are twisted spirally around each other, and the strand thus formed is covered with twisted hemp, while outside of this is a covering of sixteen galvanized iron wires also spirally wound.

A recent issue of the *Zeitschrift fur Elektrotechnik* gives some interesting particulars on the duration of currents employed in telegraphic transmission. According to this journal the currents from a Morse instrument have a mean duration of 0.125 seconds; with the Hughes from 0.04 to 0.05 seconds; with the Meyer multiple 0.007 seconds; with the Delaney multiple 0.002 seconds, and with the Wheatstone automatic 0.0018 seconds, at the rate of 600 words per minute, giving 33,600 currents per minute.

The Hamilton Electric Light and Power Co. has been organized with a capital stock of $200,000, the whole of which has been subscribed. The officers elect are: R. Æ. Kennedy, president, Robert Thomson, vice-president, J. V. Teetzel, Q.C., secretary-treasurer; D. R. Dewey, H. S. Stephens, of Hamilton, H. M. Pellatt and W. H. Howland, Toronto, and D. Graham, Montreal, directors. It is understood to be the intention of the new company to add largely to the plant and buildings for the purpose of supplying incandescent lighting and power.

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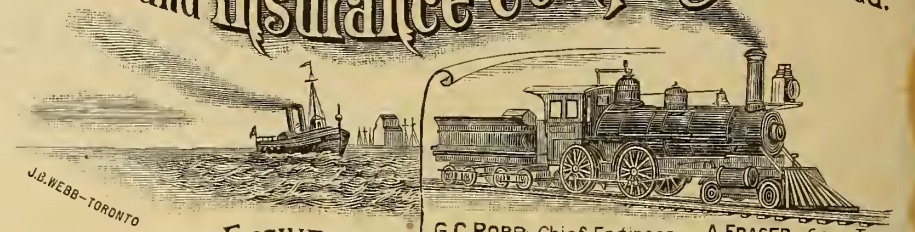
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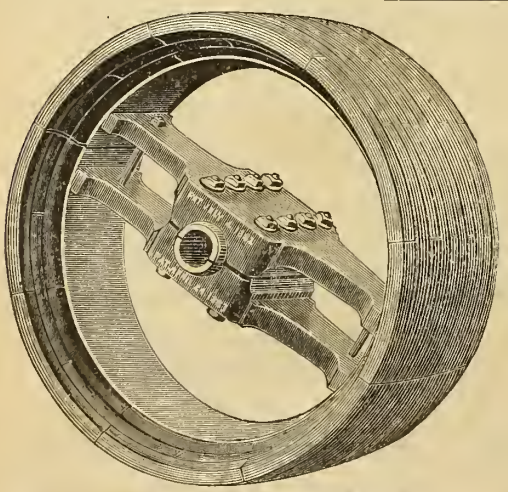
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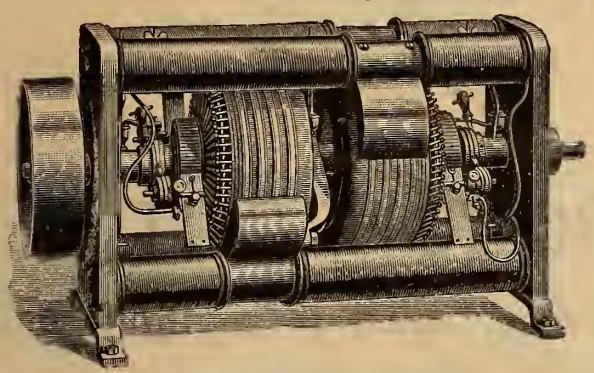
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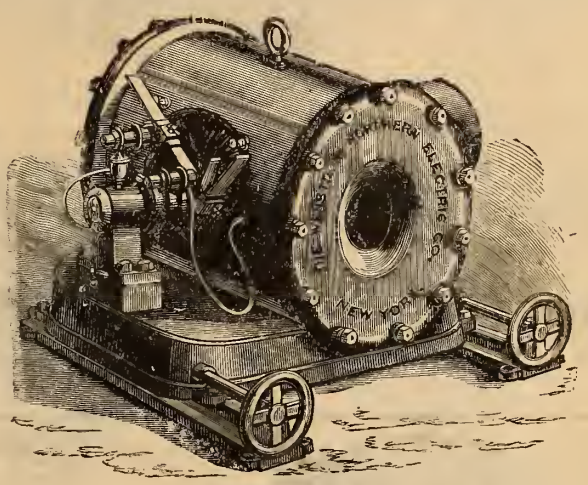
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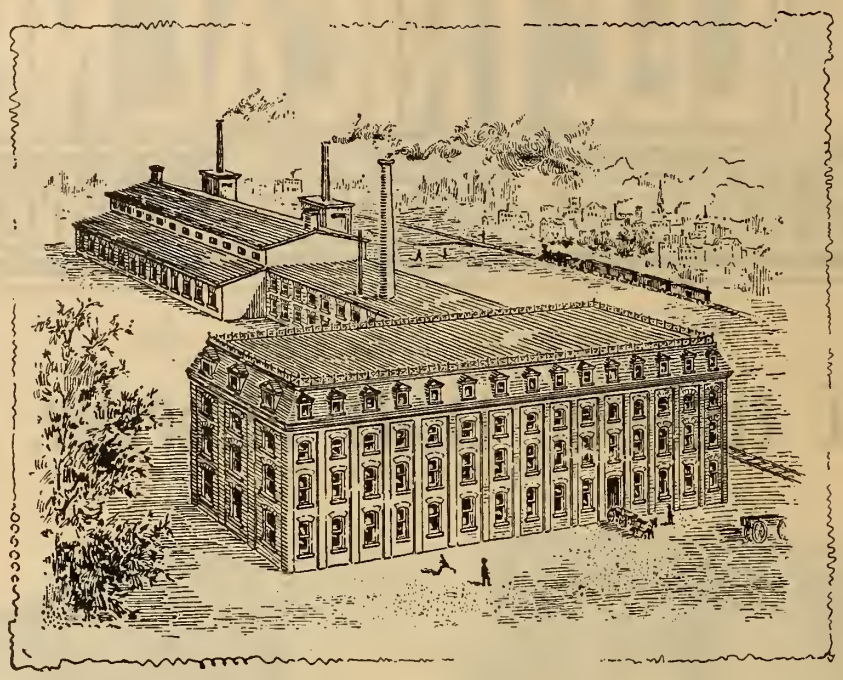
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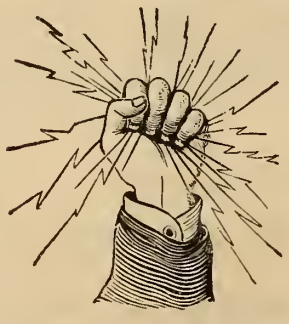
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The New Brunswick Electric Light & Power Co., St. John, N.B.

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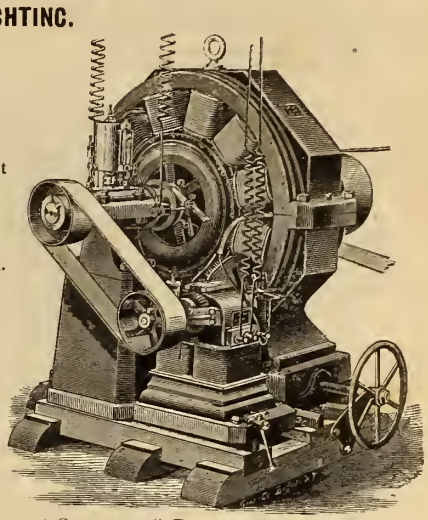
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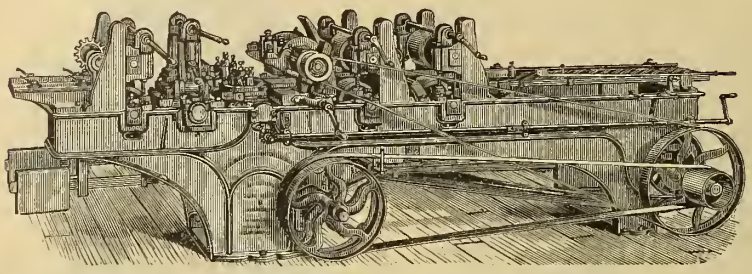
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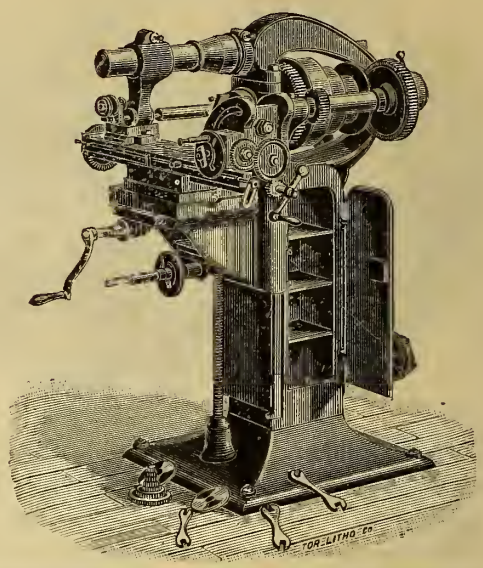
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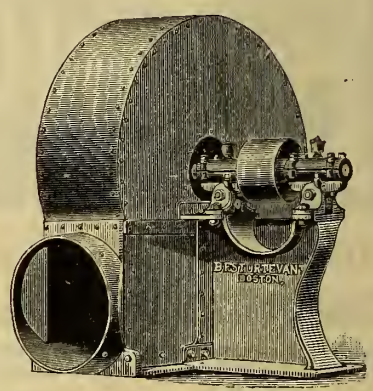
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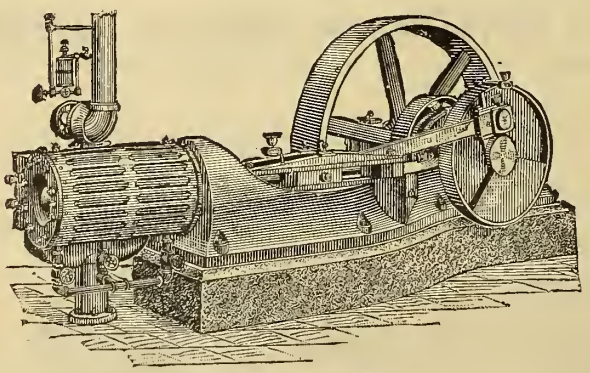
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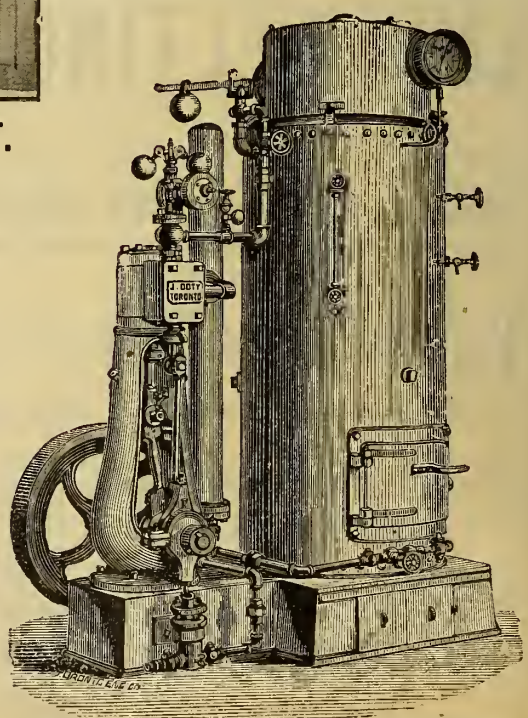
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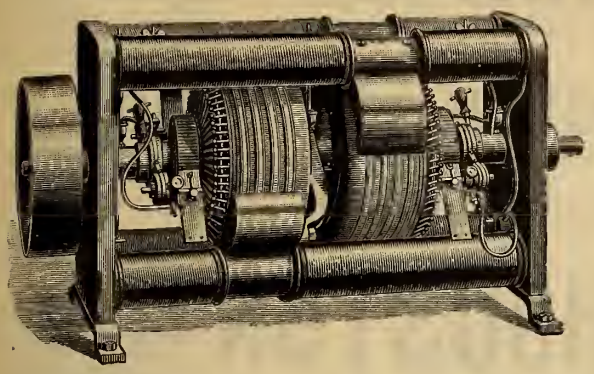
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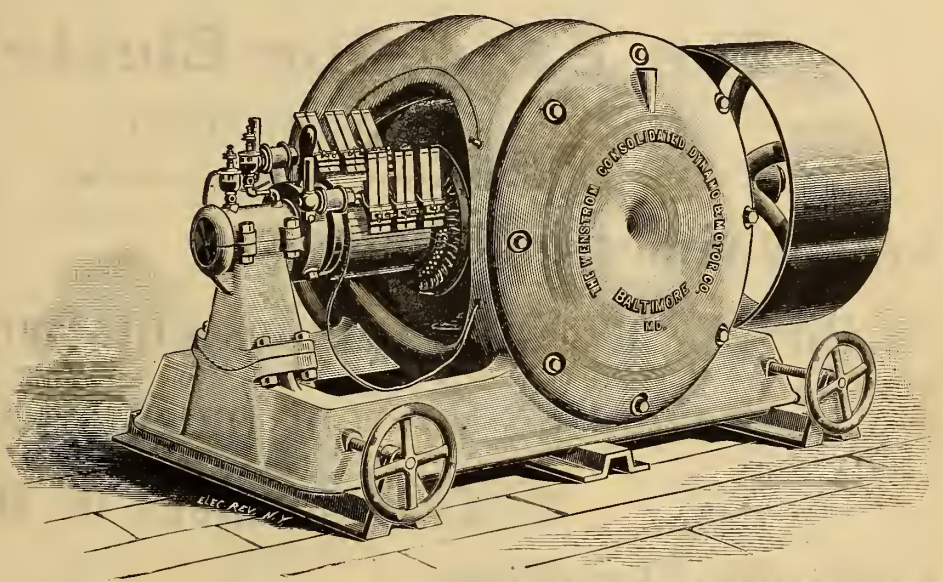
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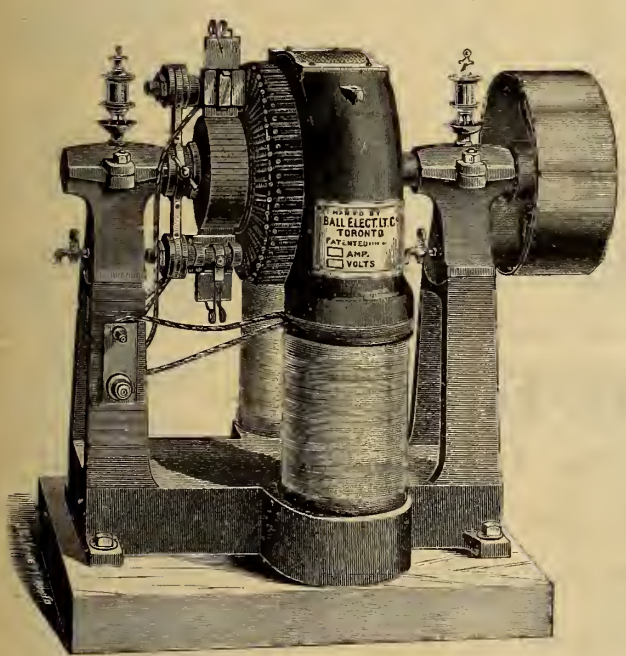
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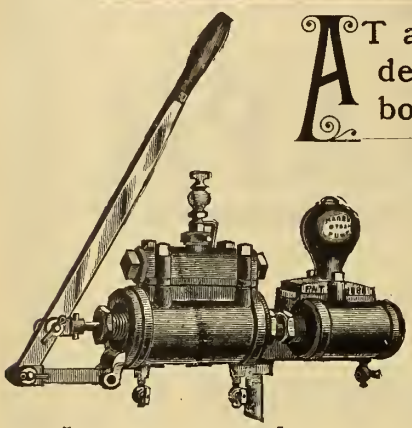
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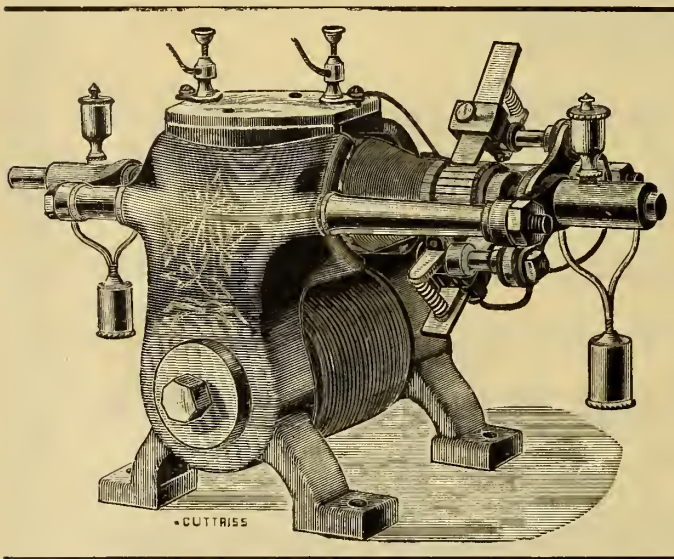
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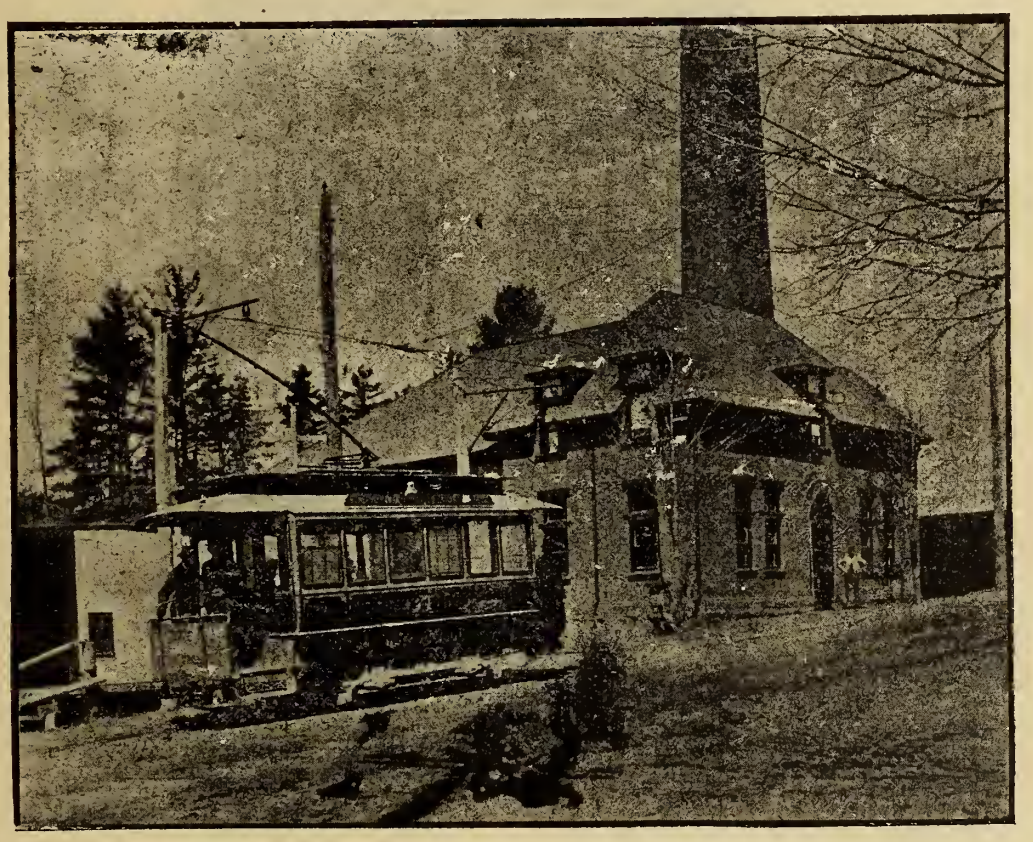
VOL. I. TORONTO AND MONTREAL, CANADA, SEPTEMBER, 1891. NO. 9.

METROPOLITAN STREET RAILWAY.

THE Metropolitan Street Railway Company is the first that has been successful in substituting electrical for animal power for the propulsion of street cars in Toronto. It has accordingly met with the favor and patronage of the public.

The company commenced electrical operations on the first of September, 1890, under the following management :—Chas. D. Warren, President; R. C. Warren, Secretary and Superintendent.

The head office and power house is a neat structure of brick and stone, situated on the west side of Yonge street, about five minutes ride from the railway crossing at North Toronto.



POWER HOUSE, METROPOLITAN STREET RAILWAY, TORONTO.

The boiler house is a lofty, solid brick building, 35 feet by 25 feet, and contains two boilers each measuring 66 feet by 14 feet, both carrying 20 square feet of grating surface, having a working pressure of 125 lbs. each. They were built by Messrs. Goldie & McCulloch, of Galt, and are fed by a No. 6 Northey feed pump. Sufficient room has here been reserved for the addition of another boiler of the same size and capacity.

The company have obtained permission to extend their track north as far as Richmond Hill. This extension will be commenced early in the spring, and when completed the length of the line will be 16 miles.

The engine room, which is on the south side of the boiler house, is 39 feet in width by 58 feet in depth, and is a model power house. Here is located a Wheelock compound condensing engine, with high pressure 13″ cylinder, low pressure 23″ cylinder, 30″ stroke, 100 h. p., the driving wheel of which measures 15 feet in diameter and 38 inches across the face, and runs at the rate of 95 revolutions per minute. Upon this great wheel is a perforated belt 83 feet long and 28 inches wide for transmitting the power to the shafting, which is built upon five stone pillars projecting up through the floor. Provision has been made for an additional engine of a similar description, and it will not be long before this is taken advantage of. Alongside the engine is a Thomson-Houston 500 volt dynamo, the armature of which runs at a speed of 900 revolutions per minute, provision also having been made for further generator power. At the west end of the room is a switch board containing voltmeter, ammeter, rheostadt, circuit breaker, main line switch and apparatus for taking potential of circuit. On the north side are the steam and vacuum gauges; in front, on the north side of the entrance, the offices and lavatory; and on the south side, a cosily furnished waiting-room. Over these offices Engineer Outhwaite has a well arranged suite of rooms, with every modern household convenience, including bathroom, heating apparatus, incandescent lights and lavatory, with hot and cold water arrangements.

Beneath the engine house is the condensing machinery, hot water well and pumps, the supply of water being taken from running springs at the back of the premises.

The car shed is located at the rear of the main buildings. As the cars come in, they are run on a transfer car and placed side by side. Hydrants have been placed in different parts of the building and every provision made in case of fire. The whole of the inside electrical plant was built by the Thomson-Houston Co. The machinery is of the latest pattern, and is arranged with a view to obtaining the best results. The premises and cars are

lighted by electricity. There are at present two cars running at intervals of 20 minutes, commencing at 6 a.m. and continuing until 1:40 p.m. each day (Sunday excepted). The cars used were manufactured by Jones Bros., of West Troy, N. Y., at a cost of $8,000 each, and are simpler than the ordinary street car in appearance, and in winter are provided with a small coal stove encased in mahogany and brass, occupying the space of one passenger, and the current passing outside the buildings along the trolley wire, and by the trolley down through the car to the motors, and from thence to the rails by the wheels. A large underground cable is laid in the bed of the tracks, to which pieces of wire are attached and extended to every junction of the rails, and so completing the return current. The motors are placed inside the floor of the cars and do their work without any noise or discomfort of any kind to the passengers.

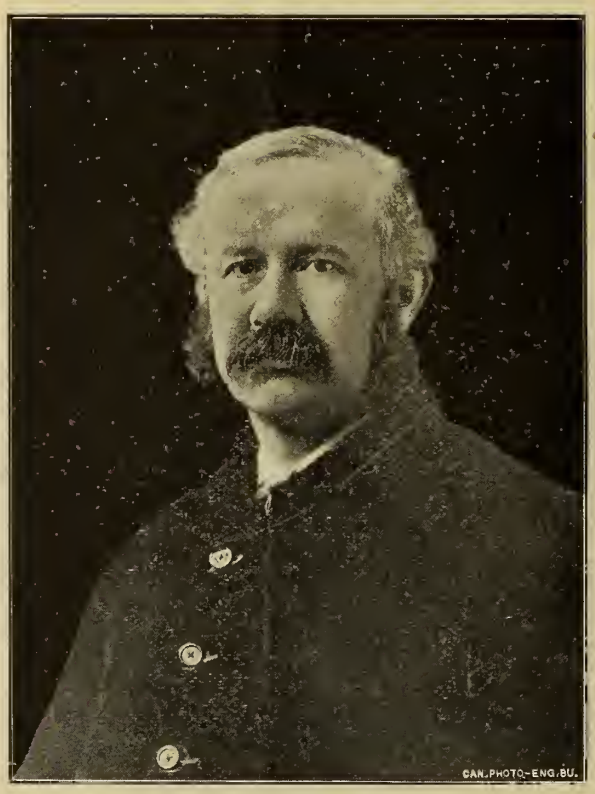
The cars are fitted up with every modern improvement, including incandescent lights and electric bells, and have gates on the platform for the safety of passengers. The capacity for obtaining a high speed whenever necessary, and the light, noiseless, easy-running, commend them to the public as a good substitute for the noisy horse cars. This is demonstrated by the traffic having already increased so as to necessitate two additional motor cars, which are now under way.

The great weight of the motors in the cars demand a heavier rail, especially in snowy weather, and the company have put down a 56 lb. T rail. This being done, a perfect degree of safety has been obtained, the running is smoother, and a great reduction of time has been made possible on each trip. The points of the track open and close as the cars pass over them, and the conductor is not required to alight from the car except to reverse the trolley pole on the overhead line at end of his journey.

The distance covered by the company is about 2¾ miles, which is run in twenty minutes, including stops, but it is expected they will be able to reduce this to about fifteen minutes.

PROF. BOVEY.

It would be difficult to overestimate the value of the service rendered by Prof. Bovey, of McGill University, on behalf of the approaching Electrical Convention in Montreal. From the moment, months since, when he consented to act as one of the representatives of the city of Montreal, he has been untiring in his efforts to provide for the pleasure and instruction of the visitors. We doubt not, therefore, that the accompanying portrait and brief outline of his career, will have an interest for many of our readers :



PROF. BOVEY.

Prof. Henry Taylor Bovey was educated at a private school in England, and at Cambridge University. On entering the University he competed for and obtained an open scholarship. On graduation he took a high place in the mathematical tripos, and shortly after was made a fellow of Queen's College. Having decided to adopt the profession of engineering, he joined the staff of the Mersey Docks and Harbour Works. He was shortly appointed one of the assistant engineers on this work, and in this capacity had charge of some of the important works then in progress.

In 1877 he was appointed Professor of Civil Engineering and Applied Mechanics in McGill University. The engineering courses in the University were at that time managed as a department of the Faculty of Arts, and were without buildings or equipment. In 1878, however, a department of Applied Science was constituted, and Prof. Bovey was elected its Dean. The magnificent endowment of the late Mr. Thomas Workman and Mr. W. C. McDonald have afforded Dean Bovey an opportunity for the display of his great executive ability and untiring energy.

Much of the success of the Canadian Society of Engineers is without doubt due to Prof. Bovey's labours as its Secretary, which position he occupied continuously from the foundation of the society until within the past few months, when increasing college duties compelled him to resign the office. Prof. Bovey is a Fellow of the Royal Society of Canada, a member of the Institution of Civil Engineers, as well as of several other engineering societies.

LIST OF COMMITTEES.

The following is a list of the gentlemen comprising the various Committees, under whose direction the programme of the Montreal Convention will be carried out :

CITIZENS EXECUTIVE COMMITTEE.—Prof. Bovey, president ; John Kennedy, vice-president; P. W. St. George, 2nd vice-president ; F. R. Redpath, 3rd vice-president ; R. White, treasurer; F. Fairman, acting treasurer ; Prof. John Cox, John Carroll, hon. secretaries ; Prof. Nicholson, Prof. McLeod, L. B. McFarlane, W. H. Laurie, W. E. Christie, J. S. Sherer, James Kent, H. M. Linnell, D. W. McLaren, J. A. U. Beaudry, C. F. Sise, A. J. Corriveau, H. Beaugrand, E. C. Arnoldi, Geo. W. Sadler, M. Perrault, L. W. Toms, S. C. Stevenson, James Harper, Phelps Johnson.

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GARDEN PARTIES COMMITTEE.—Prof. Bovey, chairman ; John Kennedy, F. R. Redpath.

PROMENADE CONCERT COMMITTEE, (at Sohmer Park).—L. W. Toms, chairman ; S. C. Stevenson, H. Beaugrand.

CONVERSAZIONE COMMITTEE.—Prof. McLeod, chairman ; Prof. Nicholson, H. M. Linnell, L. W. Toms, John Carroll.

FIRE DEPARTMENT DISPLAY COMMITTEE.—S. C. Stevenson, chairman ; E. C. Arnoldi, G. W. Sadler.

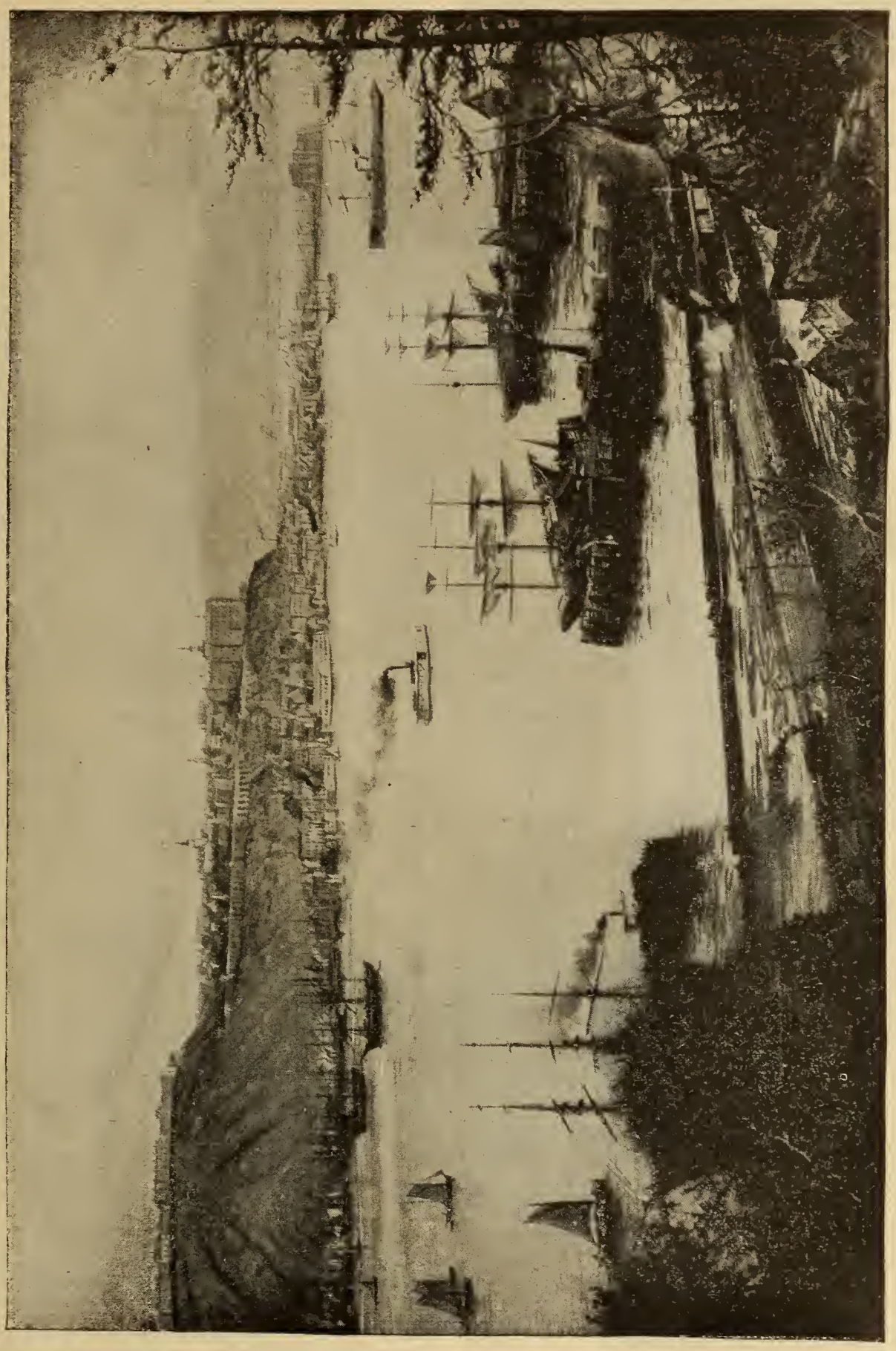
COMMITTEE ON HACKS.—L. W. Toms, chairman, A. J. Corriveau, E. C. Arnoldi.

COMMITTEE TO ARRANGE REDUCED RATES TO IBERVILLE. —A. J. Corriveau, chairman ; H. M. Linnell, S. C. Stevenson, John Carroll.

LACROSSE COMMITTEE.—W. E. Christie, chairman ; E. C. Arnoldi.

IMPORTANT NOTICE.

A meeting to informally consider the advisability of organizing a Canadian Electrical Association, will be held on Thursday, the 17th Sept., inst., at the hour of 2:30 o'clock p. m., in the offices of the Industrial Exhibition Association, Exhibition Grounds, Toronto. A cordial invitation is given to persons in any way interested in the electrical industry in Canada to be present.



THE CITY OF QUEBEC.

CANADIAN ELECTRICAL NEWS AND STEAM ENGINEERING JOURNAL

PUBLISHED ON THE FIRST OF EVERY MONTH BY

CHAS. H. MORTIMER,

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ADVERTISEMENTS.

Advertising rates sent promptly on application. Orders for advertising should reach the office of publication not later than the 25th day of the month immediately preceding date of issue. Changes in advertisements will be made whenever desired, without cost to the advertiser, but to insure proper compliance with the instructions of the advertiser, requests for change should reach the office as early as the 22nd day of the month.

SUBSCRIPTIONS.

The ELECTRICAL NEWS will be mailed to subscribers in the Dominion, or the United States, post free, for $1.00 per annum, 50 cents for six months. The price of subscription may be remitted by currency, in registered letter, or by postal order payable to C. H. Mortimer. Please do not send cheques on local banks unless 25 cents is added for cost of discount. Money sent in unregistered letters must be at senders' risk. Subscriptions from foreign countries embraced in the General Postal Union, $1.50 per annum. Subscriptions are payable in advance. The paper will be discontinued at expiration of term paid for if so stipulated by the subscriber, but where no such understanding exists, will be continued until instructions to discontinue are received and all arrearages paid.

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EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

WELCOME.

IT has become our pleasant duty in this issue to offer words of welcome to our brethren the members of the National Electric Light Association of the United States. As Canadians, we feel honored by the selection of one of our principal cities as the meeting place of such an illustrious assemblage, and we trust that the visit will not be without pleasure and ultimate profit to the dispensers of illumination, their confreres the fabricators of mechanism, and above all, to the men of mighty brain who have been most instrumental in developing the revolutionary force of electricity. Welcome one and all to the land of the beaver and the maple leaf! May your lights be never dimmed or your shadows grow less. We welcome you, from whatever part of the great Republic you come—from the sunny south or the wild and woolly west, from the land of the wooden nutmeg and the basswood ham, from New York or the sylvan state of William Penn. We are prepared to do homage to the smartest nation on the face of the earth. The effete monarchies of the old world are nowhere. In the early development of the science, the European discoverer was content to rub his coat sleeve with a chunk of sealing wax, but your Franklin had the nerve to gather his electricity from the raging thunder storm. It served Galvani's turn to tickle frogs' legs with mild electric currents, but you are satisfied with nothing less than humanity itself to practice alternating currents on. From touching up the stern of a bull-frog to electric execution is a fairly long stride, but you have made it. All hail!

Since Franklin's brilliant but cheeky experiment with a flash of lightning, the principles of the science have been discovered by men of other lands; but for the development and practical commercial applications of such discoveries, your country stands pre-eminent. Paccinotti, for instance, may have thought about a certain form of ring, but Brush made electric lights with it, and what is more, he sold them to good advantage, too. His success financially was well deserved, though it does not always fall to the lot of inventors to be rewarded in this world. Wilde and Ladd and Sawyer died poor as rats, but Thomson and Houston and Edison have succeeded in piling up on their gravestones a couple of syndicates that will presently be reaching for heaven after using up all the earth available.

Truly, yours is a great country, and as its representatives and the exploiters of a great and growing industry, we are proud to have you in our midst, and extend to you the right hand and hearty grasp of good fellowship. The Star-Spangled Banner shall be entwined with our own Union Jack, and may the sentiment of every loyal American and Canadian be: "Long may they wave!"

ACTIVE preparations are being made for the International Exhibition to be held at St. John, N. B. from Sept. 23rd to Oct. 3rd. This exhibition, it will be remembered, was a most successful affair last year, and the energy which is being evinced by the management will no doubt succeed in improving upon the results then achieved.

WE desire to acknowledge our indebtedness and tender thanks to the management of the Grand Trunk Railway Co. at Montreal, for having kindly placed at our disposal the plates from which the beautiful illustrations of the cities of Montreal, Quebec and Kingston and other Canadian scenes appearing in this paper, were printed.

AFTER having congratulated intending visitors to the Montreal convention upon the added comfort which the postponement of the meeting from August to September would afford them, it is discouraging to be told by the weather prognosticators that September will be the hottest month in the year. However, there is still a gleam of comfort to be found in remembrance of the fact that on one or two occasions weather predictions have been known to fail.

SOME time ago we had occasion to refer to the questionable method adopted by some manufacturers of electric lighting apparatus in tendering for lights in small towns at ridiculously low rates, and then on the strength of a municipal contract thus obtained unloading the plant on some unsuspecting purchaser, the sale usually being facilitated by representations of profits that can never be realized. Listowel is a case in point, with the difference that the wide-awake people there were not to be taken in. The lights were contracted for at 12 cents per night—fifteen being the number. When the company found they could not unload upon the citizens, they pulled up stakes and took their plant out of town. They were not inclined themselves to take the dose they had prepared for the people of that enterprising place, and evidently thought that the fabulous profits that were to be made out of fifteen lights at 12 cents per night were not likely to materialize. We are sorry to see such a depreciation of values by the very people whose interest it should be to maintain a price that should pay at least a reasonable interest on the investment. Where a municipal contract is to be renewed these bogus prices are quoted as actual facts, and are believed by many who have no knowledge of the true state of the case. The result is a demoralization in the business that it should be the interest of manufacturers to foster. We cannot refrain from expressing a lively hope that these brigands of the industry will profit by the lesson so hardly learned in Listowel.

THE storage battery that was promised in a week or two some months ago, to run a street car in Toronto, has, up to the present time, not materialized. We offered at the time to publish the results of a test, even though those results would compel us to eat our own words and take a back seat for evermore as a critic on things electrical. The ownership of the fundamental patent on the storage battery has been awarded to C. F. Brush after considerable litigation in the United States; but that is a matter of small concern, as it would be difficult indeed for Mr. Brush or anyone else to prove that much money had ever been made out of a storage battery. The accounting of profits need worry no one. The decision in favor of Brush may have the effect of stimulating invention on new lines, such as we have before hinted at. Before a storage battery will even be much use for locomotion it must be reduced in weight. The miserable sloppy, corroding blind electrolyte must be done away with, and a solidity and permanence given to the whole thing to which it is now a stranger. The successful storage battery is the dream of street railway men, and while once or thrice they have thought they were on the eve of realization, it has disappeared "like the baseless fabric of a vision," but it has, at the same time, in most cases, left considerable of a wreck behind. The storage battery is the ideal motive power for a street car, but it will never be attained by a rehash of the well-thumbed discovery of Faure. The inventor must strike out a new line entirely if he would succeed; and genuine success in this matter means both wealth and fame to the men who are fortunate enough to be "in it."

THE introduction of the electric motor is quickly but rapidly making headway in manufacturing establishments. The advantages of this form of power are so evident that the business man who studies his own interests cannot afford to overlook its merits. The absence of fire, smoke, noise and dirt, that are inseparable from a steam engine, and its adaptability to every position or purpose for which it may be required, are great points in its favor. It is always ready at the turning of a button and may be stopped as easily. There is no fire to put out or boiler to fill up together with the attendant risk of locking up a building and leaving it in a more or less doubtful condition of latent combustibility. The insurance underwriters recognize its desirability in this respect, and where it is in use make it a consideration in their rate on account of it. The electric motor will supersede the gas engine on account of its smoothness of motion and uniform

action, besides being free from the intolerable heat and smell and explosion of the jerky gas machine. For small powers it will be cheaper than steam, and even for larger ones the advantages enumerated above will counterbalance a slight increase in the expense. A notable field for its use will be in driving freight and passenger elevators. Its first cost will be less than for a similar power of hydraulic elevator, and its many expenses afterwards very much less. The cost of repairs to hydraulic apparatus in this city during the past year on account of sand and grit have been large, besides the risk of stoppage during the dry months on account of a shortage of water in the city reservoir. Altogether, the electric motor has a large field before it, and its merits are such that before long we may expect its use to be all but universal.

THERE will shortly be a fine chance for electrical men to show what can be done by electricity on a city street railroad. Up to the present time electric roads in Canada have been confined to one or two short lengths of suburban railway. In fact, taking the continent all over, with the exception of Boston, electric roads, though many in number, have been principally operated in the smaller cities. Large centres of population are, however, rapidly coming into line, Cleveland and Buffalo being the latest additions to the list. There is no question but that the electric car is the ideal of urban transit. Its cleanliness—the number of horses used on the streets being reduced by thousands—the decrease in wear and tear of the road, its rapidity of motion and docility — if such a word may be permitted — to the ease with which it may be handled, stopped, started and reversed in a crowded thoroughfare—are but a few of its many advantages, and for the sake of these the citizens may well afford to put up with the necessary additions to the overhead system of wires that it will entail. The conversion of the present street railroads of Toronto, which must be done in the near future, to an electric system, will involve the construction of immense steam and electric works in the city. In the first place, steam power to the extent of between three and four thousand horse power will be needed. This will require buildings, engines, boilers, pumps, immense smoke stacks and foundations. Then there will be the electric generators, which will no doubt conform to the most recent practice of large power machines driven by interchangeable mechanism to allow of each being stopped and started independently of the others. The overhead construction will require a large amount of copper and line material, and the roadbeds will require relaying with the most approved form of rails. The cars and electric motors will not be the least part of the undertaking, and if built and equipped in the city will be equivalent to the introduction of a new industry amongst us. The power plant will have to be centrally located to avoid loss in transmission and unnecessary wires, and of course will be be arranged with a view to economical fuel supply. The combined and finished work will be an extensive undertaking, and will give our electrical men a fine opportunity to show what can be done in city street railway work, besides being to the successful contractors a source of profit. If this work is commenced at once—as there is every probability—together with the meeting of electricians and manufacturers in convention in Montreal, it should give an impetus to electrical matters in the Dominion which we hope may redound to the honor and profit of all concerned.

AT a recent meeting of one of the English engineering societies, a paper was read giving a description of an experimental engine which had been constructed for the use of a Professor of Engineering in one of the technical schools. It was so arranged that work up to 150 horse power could be taken out of it, and steam of any pressure up to about 200 lbs. could be used. Different styles of valve gear could be attached, and it was believed to be the most complete and comprehensive engine ever built. In the discussion which followed, one member threw out a very valuable suggestion. It was to the effect that if he had a class to teach in the use of the steam engine, he would have an engine in which the valves would be wrongly set and the bearings loose and working badly, and then he would set the class to work with the indicator to find out what was wrong and to remedy the defect. Could not our own local Society of Stationary Engineers act upon this idea? It has been often said that every steam engineer should study indicator diagrams. The study of a diagram will not do much good, however, unless one knows something of the engine from which it was taken, and how the diagram was obtained. During the coming winter could not a class be formed to try experiments on actual steam engines? Owners of engines could be found who would be willing to allow them to be used for so good a purpose, if used under the directions of some one competent to advise and instruct the class. For example, an engine with a common slide valve might first be examined and measured, after working hours, by the class, and then put together for next day's work. During next two or three days the pressure of steam carried and coal used should be carefully noted by the engineer in charge. During those days the teacher should apply the indicator and obtain some diagrams. At the next meeting these results should be reported and studied. The setting of the valve should then be changed to whatever the majority of the class might decide would improve the engine, and for another few days the coal should be weighed and the effects of the changes noted. When a common slide valve engine had been thus studied, a Corliss and a Brown could be obtained, and the methods of testing and adjusting these valve gears practically studied. There should not be too many in a class—probably seven or eight will be found quite large enough—but the Association might form more than one class. This method of studying the steam engine would prove of immense advantage to the students, and so profitable to owners that there should be no difficulty about getting engines to experiment upon. In some cases it might be possible to get the members of the class together in the engine room while the engine was being run with a load on. In such a case, the members themselves could take the diagrams under the teacher's directions, and so obtain practical knowledge of the use of the indicator in the taking of diagrams. A class of this kind under a good teacher would do more for its members in a single winter than could be got by three times the time spent in merely studying diagrams in books on the steam engine.

WE must protest against the manner in which some parties interested in, or desiring to be interested in, the electrical business, are working to injure not only the entire electrical business, but more especially the business of certain parties who have invested large amounts in the business expecting that they would have a few years quiet in which to reap some results from their investments. We refer more particularly to the conduct of some so-called agents in going into a town where a reliable electric light company are doing business, making a canvass of the customers and would-be customers, and offering them all sorts of inducements to take lights at a lower figure than they have been in the habit of paying. Especially is this the case in certain districts of cities or towns that the local company may not have been in a position to reach yet. The mode usually adopted by these agents is to forestall the company and endeavor if possible to get a number of contracts signed at a lower price than the company have intended to offer at. Their next step is to call upon the management of the local company and offer them these contracts for a certain sum, threatening that if they do not meet their demands, they will establish an opposition plant. Not only has this mode of procedure been adopted by men of no standing, but, we are sorry to relate, companies who are doing a fairly good and legitimate business have sanctioned the actions of their own representatives in trying to force a local company into meeting their demands. This is not a legitimate way of doing business, for in ninety nine cases out of a hundred the companies using this sort of blackmail have no intention whatever of putting in a plant. The fact is, it would not pay to do so, but simply for the sake of either selling their goods or of benefiting an agent by levying blackmail upon the local company, they resort to such tactics, which not only have the effect of injuring the reputation of the local company, but injure the entire electric lighting business. Whilst we believe that good healthy competition is the life of trade, when two companies oppose each other might and main and reduce the price to a basis on which no money can be made, the result will be felt more by the manufacturers of electrical apparatus than by anyone else. This sort of thing has been going on for some time, and the sooner it is stopped and the demands of these unprincipled parties refused point blank by local companies, the more universal will the use of electric lighting become. We could understand a company who intended doing simply a constructing and operating business, indulging in a little of this sort of thing, but not running the business into the ground. This unprincipled way of doing business has been decried in the United States, and it is time that something was done in Canada to stop it before it goes too far. We believe that if local companies would stand together in such matters, the scheme would soon die out. Intending users of electricity should be very careful with whom they sign contracts. They should know positively beforehand that the parties canvassing them for their lights are responsible and reliable, and not working a scheme whereby they can levy blackmail on legitimate business. We venture to make the assertion that not 2% of the contracts for lights taken in this way within the last year have been carried out. They are simply held by the unprincipled parties who obtain them as a club over the heads of those who already have plants. We trust our readers will assist by every means in their power to cry down this unprincipled mode of doing business, and protect the parties who have invested large sums of money in electrical enterprises.

The offer of the local electric light company of Owen Sound to supply 30 or more lights for five years from October next has been accepted.

The annual convention of the Association of the Edison Illuminating Companies was held a fortnight ago in the city of New York. The convention lasted three days, and was most interesting and profitable.

The plant which is being erected by the Standard Electric Co., for supplying light and power to the citizens of Ottawa, Ont., is of an extensive character, and will be operated by three 66 inch turbine water wheels, developing 100 h. p. The shafts from the water wheels are of steel 7⅝ inches in diameter, each fitted with a mortise bevel gear wheel, 8 feet in diameter, with teeth 20 inches long. The iron pinions which work in these wheels are nearly 4 feet in diameter. The three main shafts are also of steel, 7 inches in diameter, and have on them the three main driving pulleys, which are 10 feet in diameter, and 52 inches wide. The shafting, gearing and pulleys are carried on nine massive iron bridge-trees.



GEMS OF THOUSAND ISLANDS SCENERY.

SCHOOL OF PRACTICAL SCIENCE, TORONTO.

WITH the accompanying illustrations of the School of Practical Science, Toronto, are presented a few facts concerning the history and work of the institution, which should have an interest for most of our readers, more particularly young men who are considering the subject of acquiring a technical education which will qualify them for positions in the mechanical world.

In the session of 1877 the Legislative Assembly gave its sanction to the establishment of a School of Practical Science on the basis proposed in a memorandum of the Minister of Education.

By the scheme thus approved of, the goverment effected an arrangement with the Council of University College whereby the students of the School of Practical Science enjoyed full advantage of the instruction given by its professors and lecturers in all the departments of science which were embraced in the work of the School. This arrangement was brought to an end in 1889 by the transfer of the departments in science above referred to, from University College to the University of Toronto under the operation of the University Federation Act.

There are five regular departments of instruction, in each of which diplomas are granted, viz.: Civil Engineering (including Mining Engineering); Mechanical and Electrical Engineering; Architecture; Analytical and Applied Chemistry; Assaying and Mining Geology. The instruction given in each of these departments is designed to give the student a thorough knowledge of the scientific principles underlying the practice in the several professions, and also to give him such a training as will make him immediately useful when he enters into active professional work.

The facilities possessed by the School for affording professional instruction are now being largely increased by additions to the building, equipment and teaching staff. An Engineering Laboratory is being formed which will be furnished with testing machines for testing the strength, elasticity and other qualities of materials of construction, and also with an experimental steam plant, consisting of engine, boiler, pumps, etc., for making experiments in the economical use of steam. The laboratory will be provided with pumps, tanks, turbines and other appliances necessary for conducting hydraulic experiments. It will be supplied with all necessary standard gauges, scales and measuring instruments. There will also be a full equipment of dynamos, motors, accumulators, electric lamps, measuring apparatus, etc., for the purpose of instruction in electrical engineering. There will be in connection with the laboratory a machine shop for the purpose of preparing specimens to be tested, making repairs, etc.



SCHOOL OF PRACTICAL SCIENCE, TORONTO.

In order that the students of the School might continue to enjoy the advantage of the instruction in the above departments, the Senate of the University of Toronto passed a Statute in October, 1889, affiliating the School to the University, which Statute was confirmed by the Lieutenant-Governor in Council on the 30th day of October, 1889.

By an Order in Council, approved by the Lieutenant-Governor, on the 6th day of November, 1889, a Principal was appointed, and the management of the School was entrusted to a council composed of the Principal as chairman, and the Professors, Lecturers and Demonstrators appointed on the Teaching Faculty of the School.

The Faculty of the School is composed as follows: J. Galbraith, M.A., Assoc. M. Inst. C. E., Principal. Members of the Council:—J. Galbraith, M. A., Assoc. M. Inst. C. E., Professor of Engineering, (Chairman); W. H. Ellis, M.A., M.B., Professor of Applied Chemistry; L. B. Stewart, P.L.S., D.T.S., Lecturer in Surveying (Secretary); C. H. C. Wright, Grad. S.P.S., Lecturer in Architecture; T. R. Rosebrugh, B.A., Grad. S. P. S., Lecturer in Electrical Engineering; Cesare J. Marini, Grad. S.P.S., Lecturer in Sanitary Engineering. Assistant instructor:—W. Ross, B.A., Fellow in Applied Chemistry.

The Department of Mechanical and Electrical Engineering is intended to afford the necessary preliminary preparation to students intending to become mechanical and electrical engineers. The subjects of the first year are: Mathematics—Euclid, Algebra, Plane Trigonometry; Analytical Plane Geometry. Mechanics—Statics and Dynamics (with special reference to structures and machines). Experimental Physics—Light: Use of the Heliostat and Spectroscope; Experiments with Lenses and Mirrors; Theory of the Microscope and of Reflecting instruments. Drawing—Copying from the Flat, Lettering; Graphics; Descriptive Geometry in its application to plane sided solids; Orthographic (including Isometric) and Oblique Projection. Surveying—(Lectures only, applications of Trigonometry and Principles of Measurement). Chemistry—Elementary Chemistry with Laboratory Practice. The subjects of the second year are: Mathematics—Differential and Integral

Calculus, Spherical Trigonometry; Physics — Hydrostatics, Optics, Magnetism, Electricity; Experimental Physics—Heat: Use of the Cathetometer, Dividing Engine, and Spherometer, Thermometry and Calorimetry; Drawing—Subjects of the first year continued, Coloring and Shading applied in construction drawing, Descriptive Geometry in its application to solids bounded by curved surfaces, the various projections of the sphere, Machines and Structures, (Drawings made from both copies and original notes; Engineering—Statics and Dynamics, (Pure and Applied), Theory of Mechanism, Strength and Elasticity of Materials, Materials of Construction, Methods and Processes, Experimental work in Engineering Laboratory; Chemistry—Theoretical Chemistry, Practical Chemistry, Applied Chemistry, Combustion, Fuel and Furnaces, Metallurgy of Iron and Steel. The subjects of the third year are: Experimental Physics—Acoustics, Electrical Measurements and Testing; Drawing—Subjects of the previous years continued, Descriptive Geometry: Shades and Shadows, Stone Cutting, Perspective Projection; Original Designs—Engine and Machine Design; Engineering—Subjects of previous years continued; Applied Mechanics: Mechanics of Machinery, Machine Design, Thermodynamics and Theory of the Steam Engine, Hydraulics; Electricity—Dynamos and Motors, Application of Principles to Practical Problems connected with the design, construction and testing of various Prime Motors and Machines, Experimental work in Engineering Laboratory; Chemistry (Applied)—Artificial Lighting, Photography, Explosives, Preservation of Wood, Iron and Stone, Metallurgy.

In addition to taking the course of instruction in the school and passing the requisite examinations, a candidate for the diploma in Mechanical Engineering will be required to present satisfactory evidence of having had at least one year's good practical experience in one of the principal occupations connected with mechanical work, such as machinist, pattern-maker, moulder, steam engineer, etc. There is no restriction as to the place where the candidate may have gained such practical experience.

In order to provide advanced work in the various departments and also to enable students to carry on experimental work in the laboratories with less interruption from attendance at lectures and other causes than is possible in the ordinary three years' course, it has been decided to establish a sessional course of instruction in each department to be known as the Fourth Year.

The subjects of study in the fourth year in the Department of Mechanical and Electrical Engineering are: Method of Least Squares, Theory of Observations, Strength and Elasticity of Materials, Hydraulics, Thermodynamics, Electricity, Engine and Machine Design. A great part of the work in connection with these subjects will be done in the engineering laboratory. The time of the candidates will be principally devoted to tests in connection with boilers, engines, dynamos and electric motors.

The expenses of a regular course are approximately as follows:

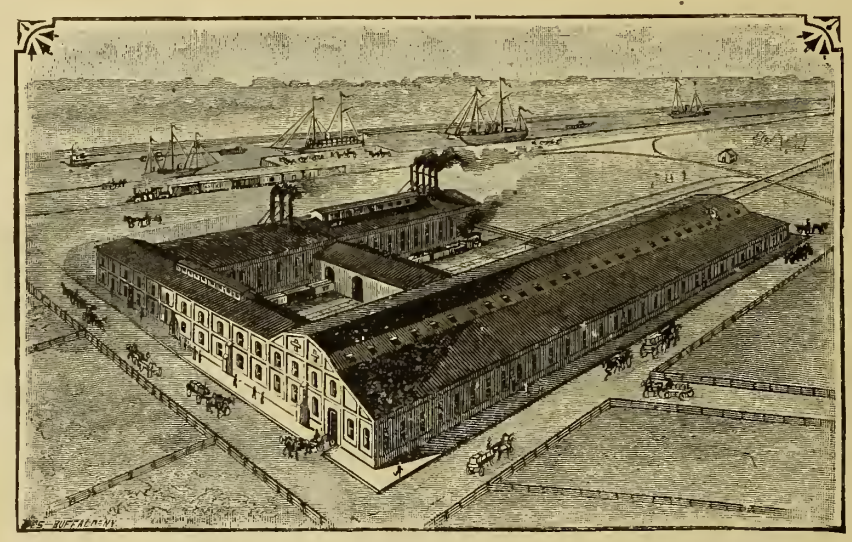
Sessional Fees	$120 00
Books, instruments, drawing materials, laboratory fees, etc., about as follows: 1st year, $60.00; 2nd Year, $40.00; 3rd Year, $30.00	130 00
Total for Regular Course	$250 00

Additions and improvements are in progress in connection with the institution. Many of them are now sufficiently advanced to enable a large amount of new work to be done next season.

DOMINION WIRE MFG. CO.

THE Dominion Wire Manufacturing Co., whose works are now situated at Lachine, and cover about 5 acres of ground, commenced operations under the style of the "Dominion Barb Wire Co." in 1880, in a small building on Foundling Street, Montreal. The business at that time amounted to only about $28,000 per year, being for barbed wire only. Since that date by judicious advertising and pushing the business, they were obliged to increase their factory, and finally decided to remove to Lachine, where they could get plenty of room for their works. Accordingly, in 1884, the company erected large works at Lachine, and having decided to draw and galvanize their own wire, and also add other industries which consumed wire, they changed the name of the company to "The Dominion Wire Mfg. Co.," under which title it is known to-day.

The main building at Lachine is 300 ft. x 100 ft., with two wings 150 ft. x 60 ft., running to the north of the main building, and two wings to the south 100 ft. x 60 ft.; two large rod sheds capable of holding from 3,000 to 4,000 tons of rods; one large warehouse to the west, 100 ft. x 50 ft.; also Hunt's automatic elevator, situated on the banks of the canal, which takes their coal and rods from the barge and delivers them where required at the works. Detached from this main building is the screw and wire rope factory. The building is 50 ft. x 150 ft., with one wing 60 ft. x 60 ft., and a warehouse 30 ft. x 40 ft. All these main buildings are built in the most substantial manner, of brick and stone foundations, and are virtually fire-proof. They have nine steam engines in operation; the largest is about 400 horse power, compound condensing. The machinery throughout is of the latest and most improved design, most of the machinery and processes being covered by patents.



WORKS OF THE DOMINION WIRE MFG. CO., LACHINE, QUE.

The company is now manufacturing all kinds of steel and iron wire, bright, annealed, oiled and annealed, galvanized, tinned, coppered, B B, and extra B B telephone and telegraph wire, nail and rivet wire, tinned mattress and broom wire. Their capacity for iron and steel wire, as above mentioned, is about 50 tons per day. They also have a further capacity of about 10 tons per day for copper, both for commercial and electrical purposes, and brass. The company has recently gone into the manufacture of copper and brass, having put down a plant which cost them about $35,000, and which is sufficiently large to cover all the increase in this trade that is likely to occur in the next ten years.

In addition to barbed wire, a capacity of about 10 tons per day, they have added to their manufacture wire nails, wood screws, hay-bale ties, and Jack-chain.

The present plant and machinery has cost the company over $250,000, and if they were able to keep the works running full time could produce over $1,000,000 worth of goods per year. No doubt, however, with the rapid development of our North West territories, in time they may be able to keep the works going steadily. They employ about 350 men, besides a large staff of office hands, the pay roll being about $10,000 per month.

The specifications for the lighting of the city of Kingston by electricity stipulate that arc lights shall be supplied at from 1,000 to 2,000 candle power. The number of lamps required will be from 87 to 100, and a number equivalent if incandescents are adopted. It is also provided that should the corporation consider it necessary during the continuance of the contract, all or any portion of the wires shall be placed underground by the contractor. This work shall be done under the supervision of the city engineer. The cost will be decided by arbitration. At the termination of the contract the city will have the option of purchasing the plant at a price to be fixed by the arbitrators.

THE GOUBERT FEED WATER HEATER

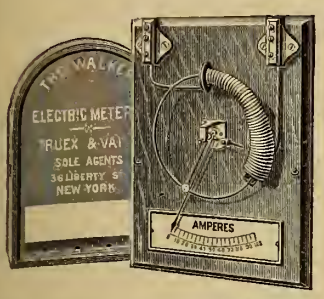
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Electrical Contractors and Dealers in Electrical Supplies.

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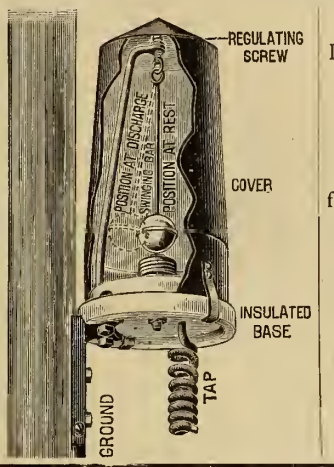
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Lightning Arrester

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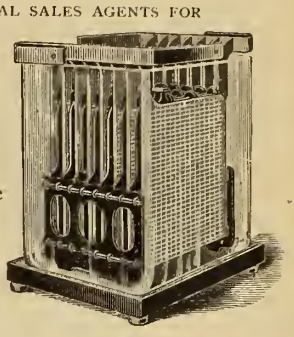
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The standard high grade insulation for Telegraph, Telephone & Electric Light work.

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ARMATURE VARNISH.
INSULATING TAPE.

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ON THE HUMBER RIVER, NEAR TORONTO.



BOLGEIL MOUNTAINS.

A CANADIAN ELECTRICAL ASSOCIATION.

THE following letters have been received in response to a circular issued by the publisher of the ELECTRICAL NEWS asking for an expression of opinion regarding the desirability of forming an association to conserve electric interests in Canada, and suggesting September 17th, as the date for a meeting of those interested to formally discuss the subject :

Wm. Bathgate, Manager Winnipeg Electric Light Co.:—"Too far for us to go."

J. Telfer, Manager Blenheim E. L. Co., Blenheim, Ont.:—"I shall be happy to meet you on the 17th of Sept. as requested."

Palmerston Electric Light Co., Limited, Palmerston, Ont :—"We will be pleased to accept your invitation to the meeting in question on Sept. 17th."

Guelph Gas Co., Guelph, Ont :—"We are decidedly in favor of a Canadian Electrical Association, and will be represented at any meeting called for that purpose."

A. Groves, Fergus, Ont.:—"Replying to yours of 1st inst., I may say I shall, if possible, attend meeting on Sept. 17th to consider the formation of Electrical Association."

S. Henry, Kincardine Electric Light Co :—"At present I cannot say whether I will be able to attend meeting to be held on the 17th of Sept. or not. If possible, I will do so."

Dominion Electrical Manufacturing Co., Toronto :—"We think as you do, that an Electrical Association for Canada is what we need, and will do all in our power to aid same."

C. A. Phillips, Midland Electric Light Co., Midland, Ont.:—"I will be pleased to see organized such an Association as you speak of, and will attend a meeting as proposed by you."

Bowman & Zinkan, Southampton, Ont :—"We received your circular, re Canadian Electrical Association. We cannot be present on Sept. 17th, but we think such an association might be of some benefit."

F. N. Saylor, Strathroy, Ont.:—"In reply to yours of 1st inst., I cannot be in Toronto at that date. An Electrical Association would be a great benefit to the Canadian electrical industry, but I regret I cannot take part."

W. Moore & Sons, Meaford, Ont.:—"In answer to your inquiry with reference to a Canadian Electrical Association, we would be pleased to become a member of it, and could no doubt attend a meeting in Toronto during Exhibition week."

A. W. Brice & Co., Hamilton, Ont :—"Yours of the 1st inst. to hand, and in reply we beg to express our approval of an Electrical Association being formed in Canada, and will, if possible, be represented at the proposed meeting on Sept. 17th."

D. McDonald, Manager Electric Light & Power Co., Orangeville, Ont.:—"In answer to your circular of the 1st inst., I will be most happy to attend the meeting you speak of, to be held in Toronto on Sept. 17th for the formation of a Canadian Electrical Association.

Roberts Storage Battery and Electrical Construction Co., Toronto :—"Concerning your letter of the 1st inst., we beg to say that we think the suggestion a good one, and anything that we can do to further the practical working out of the idea will be gladly done."

Manager Electric Light Co., Cannington, Ont.:—"In reply to yours *re* formation Electrical Association, I think such a move would be one in the right direction, and would be pleased to attend on date mentioned, if no unforseen occurrence arises to prevent my doing so."

Yarmouth Gas Light Co., Limited, Yarmouth, N. S.:—"Your circular letter duly received, and contents carefully noted. I am pleased to know of the intended formation of an Electrical Association, and am fully in accord with your views, and will, if possible, attend your meeting."

New Glasgow Electric Light Co., New Glasgow, Nova Scotia:—"We heartily concur in your idea to have an Electrical Association formed. We can't say whether it will be possible for any of our staff to attend your meeting, but whether we get there or not, we wish you success."

I. J. Gould, Uxbridge Electric Light Co.:—"In reply to yours of the 1st inst., I think the proposition to form a Canadian Electrical Association is a good one, and should business engagements permit, I will be pleased to attend a meeting on the date named in your letter."

W. J. Clarke, Trenton, Ont.:—"It would give me great pleasure to be present at the meeting on Sept. 17th next (if possible), and to take an active interest in the work of organization. Please notify me at Trenton a few days before the meeting so that I will not overlook it."

Aylmer Electric Light Co., Aylmer, Ont :—"Received your circular in *re* meeting September 17th to discuss the advisability of forming a Canadian Electrical Association. We are not certain whether we will go down to Toronto at that time, but if we do will try and be present at the meeting."

A. A. Wright & Co., Renfrew, Ont.:—"Your circular of the 1st inst. *re* formation of a Canadian Electrical Association, is just to hand, and in reply would say that we are heartily in accord with the movement, and shall do our best to be present on the 17th of September as suggested in your circular."

Stormont Electric Light and Power Co., Cornwall, Ont.:—"In reply to your circular of July 1st, we would state that our company would be pleased to belong to such an association as you mention, but at present we are unable to say whether we could send anyone to attend the meeting at the date mentioned."

Paris Electric Light Co., Paris, Ont.:—"Your communication of July 1st received and contents noted. We approve of the idea of forming a Canadian Electrical Association, and will help it along as far as it may be possible for us to do so. Expect to be in Toronto during the Industrial Exhibition, and will make it a point to attend meeting."

Fredericton Gas Light Co., Fredericton, N.B.:—"Your circular letter of 1st inst. is before me. I regret very much that I will be unable to attend your proposed meeting of those interested in electrical matters, to be held at Toronto on Sept. 17th. I am too new to the business to offer any suggestions to those who I hope will attend your meeting."

Toronto Electrical Works, Toronto, Ont :—"We have your note of July 1st at hand, in reference to the organization of a Canadian Electrical Association. We shall be very glad to meet with those who are interested in the formation of the proposed society, and to give it our support. Such a society to be a success in Canada, should be very broad in its character and scope."

St. Thomas Gas and Electric Light Co., H. Brown, Manager, St. Thomas, Ont :—Your circular, *re* Electrical Association, is before me, and in reply, beg to say that I am in favor of such organizations, for no doubt they are a great benefit to all concerned. As I am not a practical electrician, it would not be my business to take any part in the formation of such an association, but if allowed to do so afterwards, I should consider it a privilege to become a member."

M. D. Barr, District Manager, Edison General Electric Co., Toronto, Ont.:—"I have yours of July 1st regarding formation of society to be called the 'Canadian Electrical Association.' I understand that there is a society of this kind in Montreal. Would it not be well to correspond with them, and make some kind of a combination for a National Association. I shall be pleased to be at the meeting, and will do what I can to forward the interest of such a society."

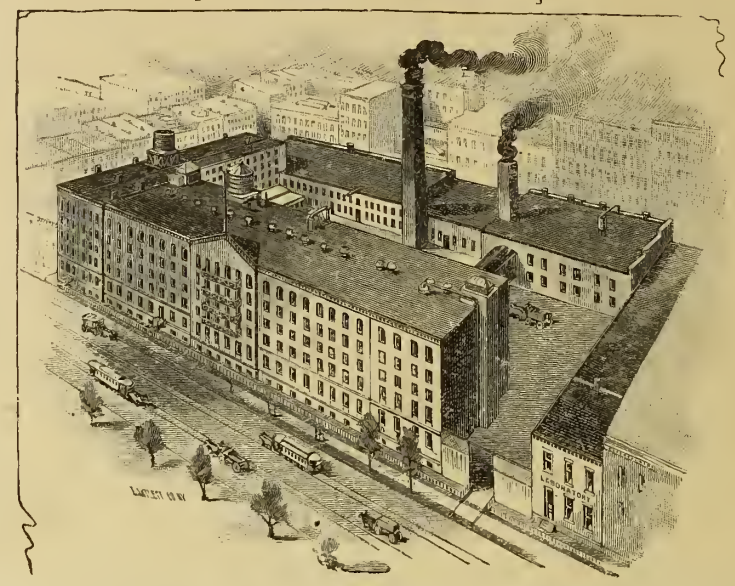
Louis Perrault, Manager Perrault Electric Light and Power Co., Montreal :—"I am in receipt of your favor of the 1st inst., and in my opinion I think the best thing to do is for Canadians to join the American Electrical Association, inasmuch as we have every thing to learn from our neighbors who are far ahead of us in that line. If I understand aright, the formation of such a society is for the promotion of electric interests in the country, and the organizing of exhibitions to instruct the people and make them acquainted with the progress of the industry, and as we have very little to boast of in our country, we had better join the existing one in the neighboring republic and be proud of being members of an important body in the advancement of science. I am sorry to say I will not be able to attend the proposed informal meeting to be held in Toronto on the 17th of September next, with a view of establishing such an association, owing to pressure of business here at that season, but will be glad to assist you in this city in my business capacity only, not being myself a practical electrician."

A new cable will be laid between Detroit and Windsor by the Bell Telephone Co. The old cable is badly damaged and part of it is caught on a wreck on the bottom of the river and cannot be released. One half of the cable has been cut away and the company think it more advisable to put in an entire new one than attempt to repair the present one. The new cable will be brought from Germany and will require about six weeks to get and put in working order.

SAWYER-MAN ELECTRIC Co.

[INCANDESCENT LAMP FACTORY.]

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ELECTRICAL ENGINEERS,

GENERAL ELECTRICAL INTELLIGENCE BUSINESS.

UNDER the above heading we have considered a very important feature of our business which will be entirely unique and commendable. To any Isolated Plant we offer at a very moderate subscription price ($25.00 a year) the privilege of corresponding upon any electrical subject of practical interest. Thus an isolated plant will be able to secure expert information as to its own plant, the best methods of operating it, and about any new electrical apparatus or methods and the principles underlying various devices and the prices thereof. For Central Station and Street Railway Companies, whose queries would go further into Steam Engineering and methods of distribution, and also would cover business questions as to relations with consumers, systems of accounts, etc., the annual subscription charge for this electrical intelligence will be $50.00.

In case the expert judgment of the Company be desired as to comparative merit of various competing apparatus or methods, such expert judgment will be given by special arrangement, although the Company prefers to merely supply full information under the subscription arrangement and allows the purchaser to form his own conclusions.

SUBSCRIPTION CONTRACT.

H. WARD LEONARD & CO. 189

Gentlemen: Please enter the subscription of the undersigned for such electrical information as may be requested of you, subject to the following conditions:

FIRST.—The subscriber shall have the privilege of calling for any information which he considers may be of practical value to him in the operation of his plant.

SECOND—All queries shall be by correspondence only.

THIRD.—H. Ward Leonard & Co. shall not be called upon under this yearly subscription to give its expert judgment on the comparative merit of various apparatus or systems, but shall furnish full descriptive information regarding the character, principles, methods, forms, catalogues, prices, etc., involved by the questions, as far as they are able to.

FOURTH.—All information supplied to the subscriber shall be confidential and for his information only.

FIFTH.—This subscription shall be for one year from date and at the rate of Twenty-Five Dollars per year.

Signed .....

The usual subscription is by the year. To enable subscribers to judge of the merits of such a plan, the Company will make the following special offer:

SPECIAL NOTICE.

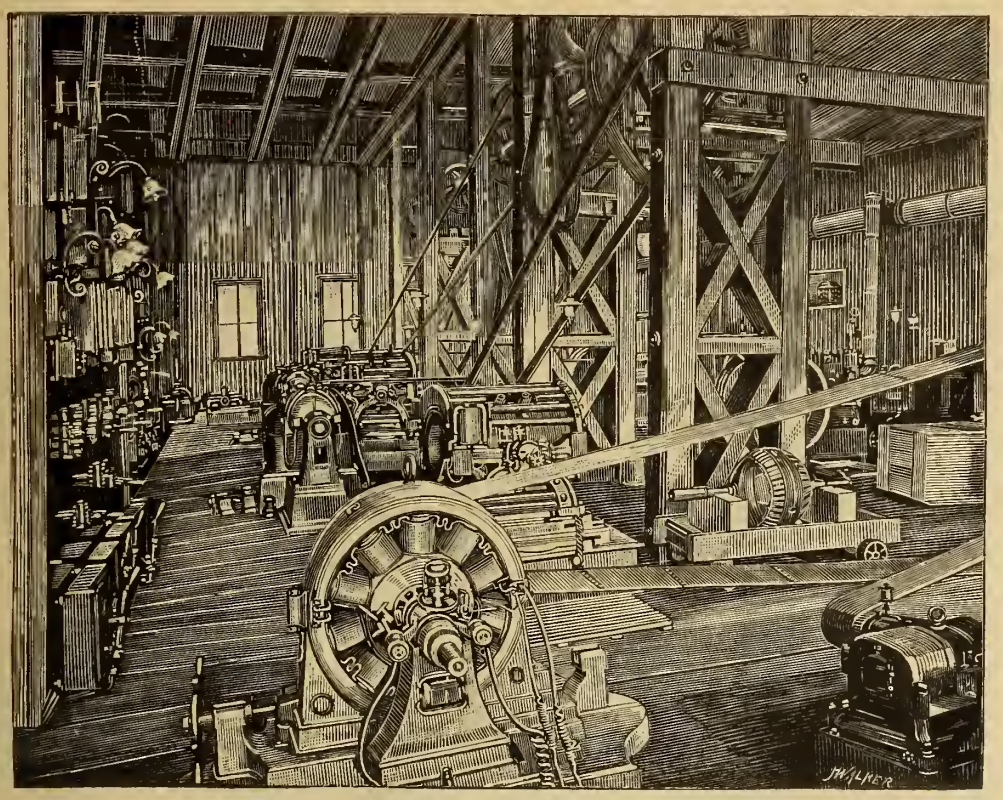
To all parties signing the above subscription contract and returning same to the Company promptly, it will agree that the date of the expiration of the contract is December 31st, 1892.

To parties other than Isolated Plants and Central Stations, special quotations will be made for these services on application.

Address: ELECTRICAL EXCHANGE BUILDING, NEW YORK.

THE VANCOUVER ELECTRIC RAILWAY AND LIGHT CO.

THE Vancouver Electric Railway & Light Co., Ltd., was formed less than two years ago by the consolidation of the Vancouver Electric Illuminating Co., and the Vancouver Street Railway Co., and at once began the construction of a plant for operating the street railway and arc and incandescent lighting systems.



DYNAMO ROOM, VANCOUVER ELECTRIC RAILWAY AND LIGHT COMPANY.

One year ago last June it began actual operation with the apparatus shown in the accompanying photographs of engine and dynamo rooms.

The electrical machinery is comprised of three fifty light Thomson-Houston arc machines from the Royal Electric Co. of Montreal, two 750 light Westinghouse alternators with separate exciters, and two 80 h. p. Thomson-Houston railway generators from Lynn, Mass. The steam plant consists of one Westinghouse and three Armington & Sims engines of 100 h. p. each.

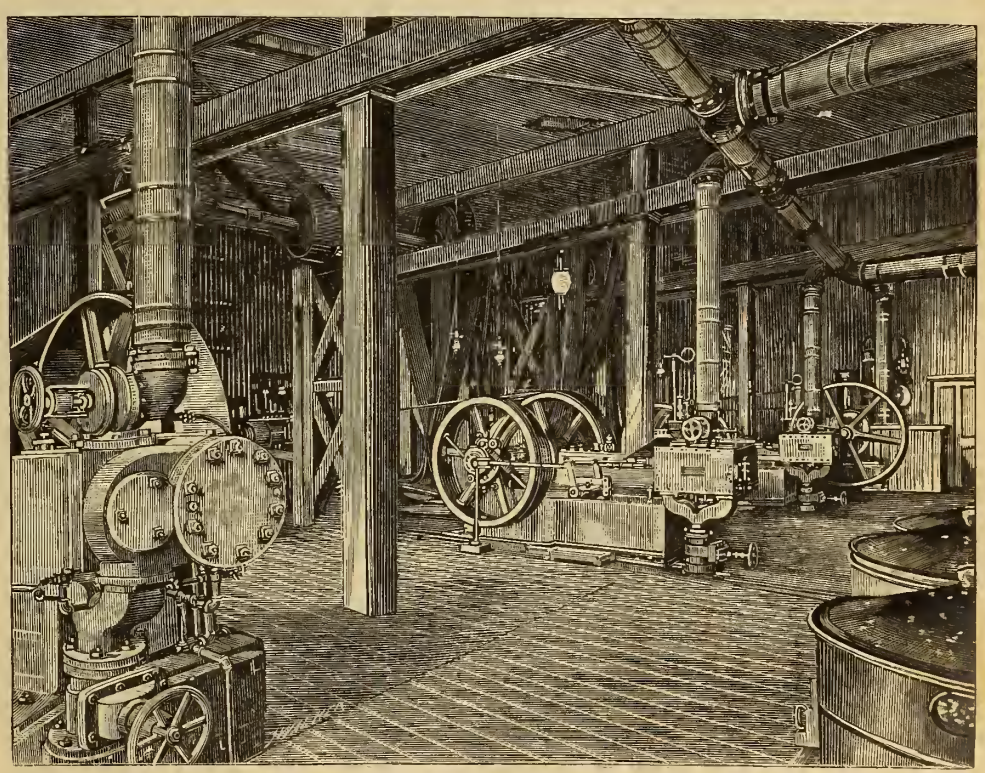
By means of the elevated counter countershaft almost any combination of dynamos and engines may be obtained, so that a serious interruption of service is very nearly impossible. The buildings are situated on Barnard Street, near Westminster Ave., and have a wharf frontage on False Creek of 180 feet, so that the company is able to bring coal direct from the mines on scows in large quantities.

The power house is a brick veneered building one story in height and 70 x 85 feet on the ground. Early in the present year it became evident that the present buildings would furnish inadequate space for the coming winter, and a two story addition 50x85 feet has been added, making the whole building 85 x 120 feet. The addition to the engine room will contain a Westinghouse compound engine and three T.-H. generators, and leave the engines now in use for railway work available for lighting. The second story of the new building will be used for storerooms and offices.

The car house has been doubled in size, and is now 45 x 120 feet. The company has 3½ miles of road in operation, and is now engaged in building about five more, which will be completed this fall. Twenty-five pound rails were used in the present track, but nothing less than 40 lb. rails will be used in future. The guage is standard, and the maximum grade five per cent. Six cars are now in use—four with two 10 h. p. motors each, and two with 15 h. p. motors. The cars were manufactured by the John Stephenson Co. and the motors by the Thomson-Houston Co. Four new cars by the same maker are being equipped with two 20 h. p. Westinghouse motors each, as some of the grades on the extension run as high as eight and nine per cent.

Both the arc and incandescent systems are loaded to their full capacity, and additions will be made to them at once. The plant is thoroughly equipped with testing instruments in all departments to assist in carrying out the company's policy of taking every precaution against the interruption of service.

Mr. F. L. Dame, formerly district engineer of the Westinghouse Co. at Portland, Ore., is superintendent. Collections and miscellaneous business are looked after by Mr. W. E. Brown, who has the title of business manager. T. E. Barnett is chief engineer. Owing to the resignation of Mr. H. E. McKee, who has held the presidency since the organization of the company, that office is now vacant. The officers are: T. Dunn, vice-president; H. T. Ceperley, Sec.-Treas.; Directors—T. Dunn, J. W. Horne, M.P.P., C. D. Rand and Geo. Turner.



ENGINE ROOM, VANCOUVER ELECTRIC RAILWAY AND LIGHT COMPANY.

While the gases of combustion from the thorough burning of one pound of coal would be from 276 to 533 cubic feet at 500 degrees Fahrenheit, they would at 62 degrees occupy only 150 to 290 cubic feet; and this agrees pretty closely with the 140 cubic feet of air at 62 degrees Fahrenheit required to completely burn one pound of coal.



CITY AND HARBOR OF KINGSTON, ONT.

McGILL UNIVERSITY.

THE accompanying engravings will serve to illustrate the new W. C. McDonald Engineering Building and the Physical Building in connection with McGill University, Montreal. Some particulars are appended concerning the institution, the course of studies prescribed for students of electrical and mechanical engineering, and the facilities afforded the youth of Canada for acquiring a technical education.

The Faculty of Applied Science is composed as follows :— Sir William Dawson, C.M.G., L.L.D., F.R.S., Principal ; Henry T. Bovey, M.A., M. Inst. C. E., F.R.S.C., Dean of the Faculty. Professors—B. J. Harrington, B.A., Ph.D., F.R.S.C., Greenshields Professor of Chemistry and Mineraology ; Henry T. Bovey, M.A., M. Inst. C. E., William Scott Professor of Civil Engineering and Applied Mechanics ; C. H. McLeod, Ma.E., Professor of Surveying and Geodesy, and Superintendent of the Observatory ; G. H. Chandler, M.A., Professor of Practical Mathematics ; Charles A. Carus-Wilson, M.A., A.M. Inst. C.E., A.Inst.E.E., W. C. McDonald Professor of Electrical Engineering.—Associate Professors — Sir William Dawson, L. L. D., F.R.S., Logan Professor of Geology, and Professor of Natural History ; Pierre J. Darey, M.A., B.C.L., L.L.D., Officier d'Académie, Professor of French Language and Literature ; Charles E. Moyse, B.A., Molson Professor of English Language and Literature ; D. P. Penhallow, B.Sc., F.S.S.C., Professor of Botany ; John Cox, M.A., W. C. McDonald Professor of Experimental Physics.—Associate Lecturers—Paul T. Lafleur, M.A., Lecturer in English ; P. Toews, M.A., Lecturer in German Language and Literature ; Frank D. Adams, M.A.Sc., Lecturer in Geology.—Assistants—Andrew T. Taylor, F.R.I.B.A., Instructor in Freehand and Model Drawing ; Percy Norton Evans, B.A.Sc., Assistant in Practical Chemistry.

The Professorship of Mechanical Engineering and the Lectureship in Mining are to be filled before the beginning of next session.

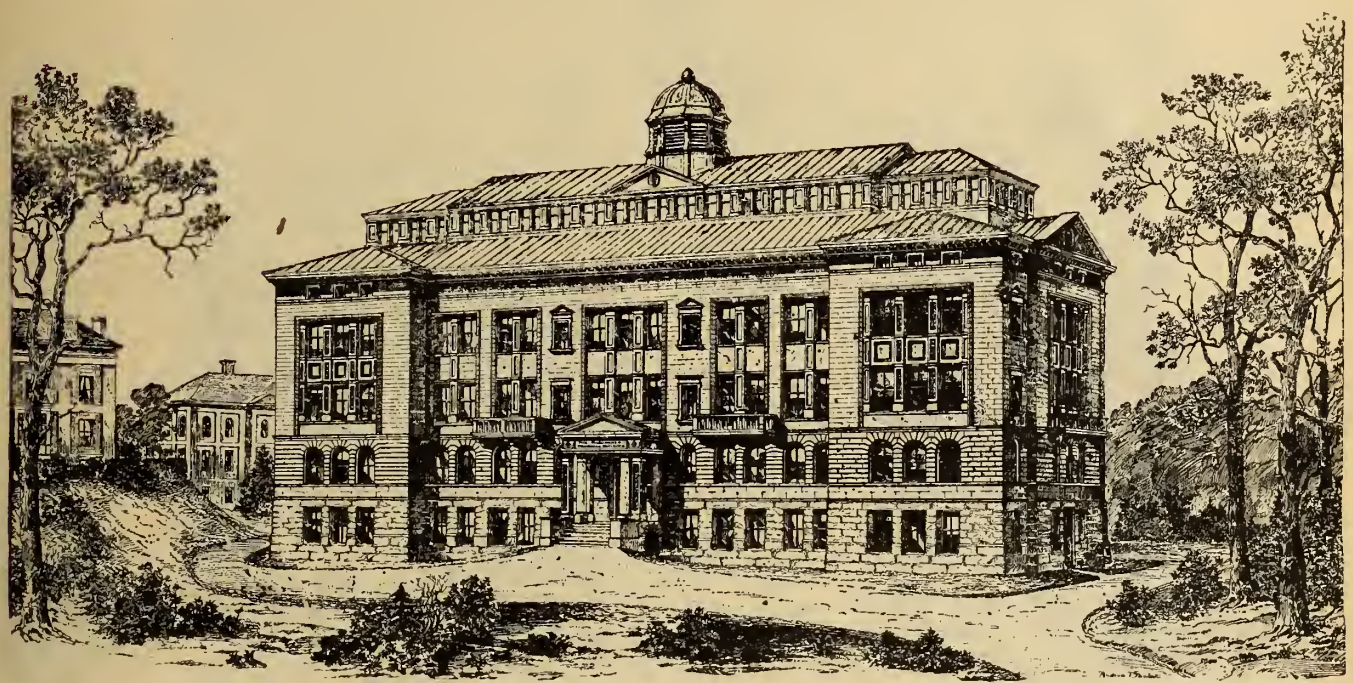
The instruction in this Faculty is designed to afford a complete preliminary training, of a practical as well as theoretical nature, to such students as are preparing to enter any of the various branches of the professions of Engineering and Surveying, or are destined to be engaged in Assaying, Practical Chemistry, and the higher forms of Manufacturing Art.

Five distinct Departments of study are established, viz :— Civil Engineering and Surveying ; Electrical Engineering ; Mechanical Engineering ; Mining Engineering ; Practical Chemistry. Each of these extends over four years, and is specially adapted to the prospective pursuits of the student.

The course in Electrical Engineering is based on a thorough training in mathematics and experimental physics gained during the first three years. In the fourth year the student will enter the Electrical Engineering Laboratory, where the practical application of physical laws and methods is illustrated in the working of the apparatus with which the Laboratory is equipped.

The lectures and class work in the Department of Mechanical Engineering are devoted to a study of the principles of Kinematics and Dynamics of Machinery, and of Thermodynamics. Work is done in the Mechanical and Thermodynamic Laboratories, where the practical application of the theories discussed in the lecture room is illustrated. The student will also go through a course of Mechanical Drawing and of workshop practice.

In the Laboratories the student will be instructed in the art of conducting experiments. The principal experiments carried out in these will relate to the elasticity and strength of materials, friction, the theory of structure, the accuracy of springs, gauges, dynamometer, etc., the efficiency of shafting, gearing, etc. The equipment will include a 100 ton Wicksteed and a 75 ton Emery machine for testing the tensile, compressive and transverse strength of materials. The Laboratories are also provided with an autographic torsion machine for testing the torsional strength of materials, machines for determining the effect of repeated stresses, oil testers, steam extensometers, etc., and a very complete supply of gauges, micrometers, and other apparatus for exact measurements.



McDONALD TECHNICAL BUILDING, McGILL UNIVERSITY, MONTREAL.

The Laboratory of Mechanics is fully equipped with a variety of apparatus, such as chronographs for measuring small intervals of time, pendulums for determining the acceleration of gravity and other dynamical constants, machines for deducing the laws of falling bodies, etc.

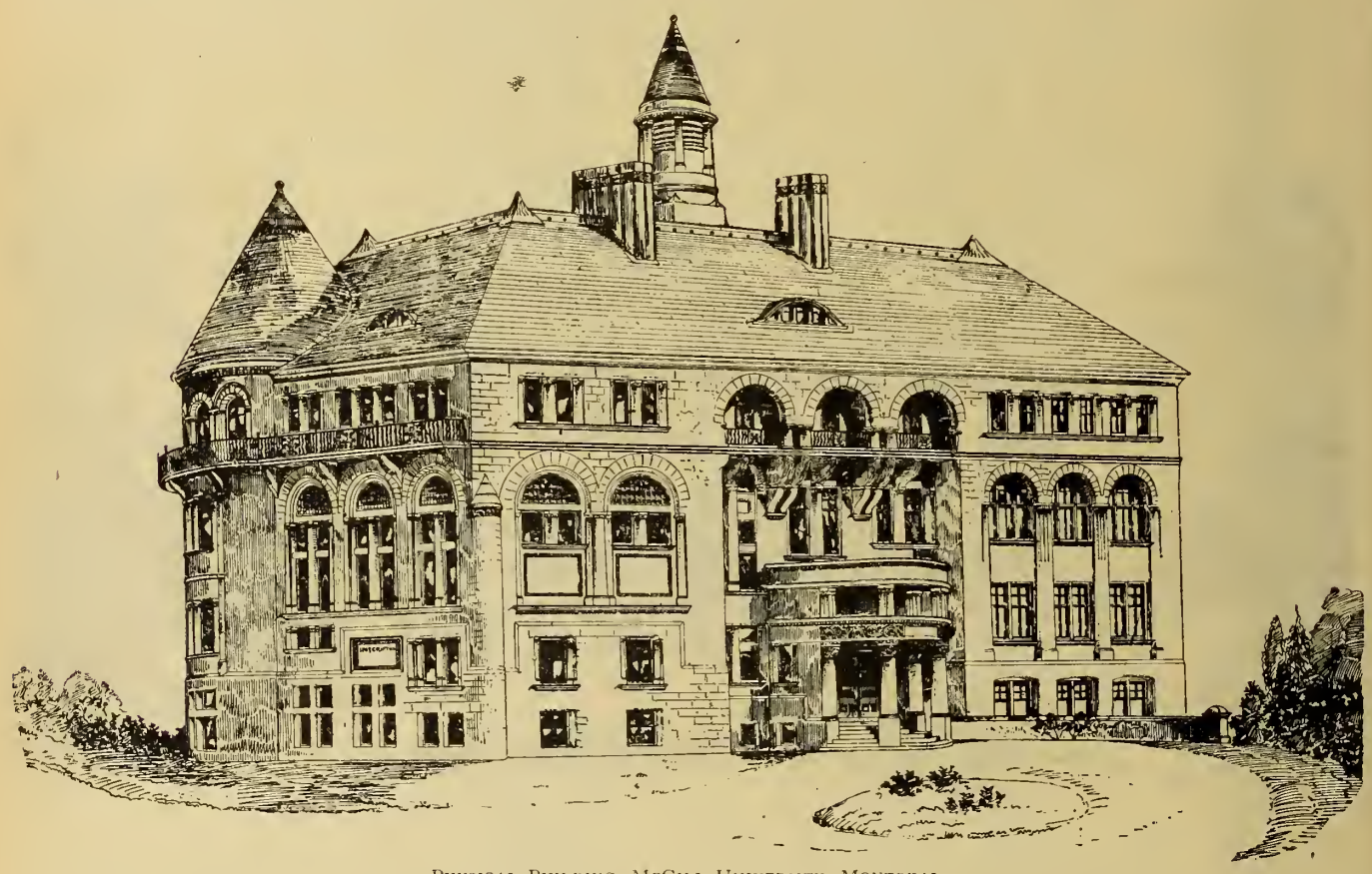
The Thermodynamic Laboratory is furnished with an experimental steam engine of 80 I.H.P., specially designed for the investigation of the behaviour of steam under all possible conditions ; there are four cylinders, which can be connected so as allow of single, compound, triple or quadruple expansion, condensing or non-condensing, with or without jackets. The measurements of heat are made by large tanks, which receive the condensing water and the condensed steam. There are two hydraulic absorption brakes for measuring the mechanical power developed, and an alternative friction brake for the same purpose. The Laboratory is further equipped with a variety of apparatus for the investigation and illustration of the general principles of thermodynamics, including hot air and other engines, indicators, pyrometers, pressure gauges, etc.

The equipment of the Electrical Engineering Laboratory includes a high speed steam engine coupled direct to a dynamo for incandescent lighting ; a slow speed steam engine for driving the experimental dynamos. These latter have been chosen to represent the best types now in general use, both of high tension and low tension direct current dynamos—with various methods

of winding, and also of alternating current dynamos of low tension, and of high tension for use with transformers.

Arrangements have been made for measuring mechanical power supplied to the dynamos and given out by the electromotors, of which there are several types; these arrangements comprise various forms of belt, rope and transmission dynamometers, with a very perfect form of hydraulic absorption dynamometer, with which the accuracy of the others can be checked by readings in absolute measure. The well-known form of cradle dynamometer, for dynamo testing, finds a place here, and special facilities are provided for varying the speed of the dynamos within any required limits.

The instruments for making the electrical measurements will enable measurements of current resistance, and difference of potential to be made with great accuracy, not only in the detached laboratories but in the dynamo room when the machinery is running. In separate rooms there are standard instruments with which the correctness of the working instruments can be readily checked. These include, amongst others, two of Sir William Thomson's electric balances. There are also a variety of instruments for special purposes connected with electrical measurements, such as instruments for determining coefficients of self and mutual induction, etc.



PHYSICAL BUILDING, MCGILL UNIVERSITY, MONTREAL.

The Electrical Department, in which many of our readers will feel an especial interest, has been placed upon a sound basis by the generous endowment of Mr. W. C. McDonald.

In the early years of its history the usefulness of McGill University was largely curtailed by want of adequate means, but of late years, thanks to the benificence of several of the leading citizens of Montreal, it is now in a position to do for the youth of this country what larger institutions of similar character have done and are doing for the young men of America.

FEED WATER HEATERS.

VICTORIA, B. C., August 3rd, 1891.

Editor ELECTRICAL NEWS.

DEAR SIR,—In the July number of your valuable paper I see a feed water heater, with an article appertaining to the same, which sets forth its advantages, but I cannot see where they come in, as by introducing the feed water into the space, thereby converting that part of the boiler into a jet condenser and getting wet steam for the engine, is the very thing we try to avoid.

As to its being a scale forming preventive, I do not think it has any bearing whatever. My experience has been with salt water, and by observation I find that the hottest part of the boiler has the most scale deposited on it, irrespective of the place the feed water is inserted into the boiler. But I have observed that the circulation is affected by the introduction of the feed, which, in my humble opinion, should be inserted where the current is strongest.

I cannot see how a spray in the boiler would be the means of holding the limes in solution either in fresh or salt water.

The above are my crude ideas. I would like if some of your more able readers would give me more light on the subject. Thanking you in anticipation for your kindness in publishing the above, I remain,

Yours truly,

"ENGINEER."

BRANTFORD BRANCH NO. 4, C.A.S.E.

BRANTFORD, August 15th, 1890.

Editor ELECTRICAL NEWS.

DEAR SIR,—The following were recently elected officers for the ensuing year:—Bro. Thos. Pilgrim, President; Bro. C. A. Walker, Vice-President; Bro. Jos. Ogle, Recording-Secretary; Bro. L. A. Fordham, Treasurer; Bro. J. Nichols. Conductor; Bro. H. McKinnon, Door-Keeper.

Bro. Ames, past President, installed the officers, and afterwards made some very suitable remarks, urging the members to attend regularly, propound abundance of questions for discussion, and make good use of the blackboard.

Bro. Ames has filled the President's chair since the organization of No. 4, but has declined the offer of a further term in favor of Bro. Pilgrim. He is ever ready and always willing to work for the interests of the C.A.S.E.

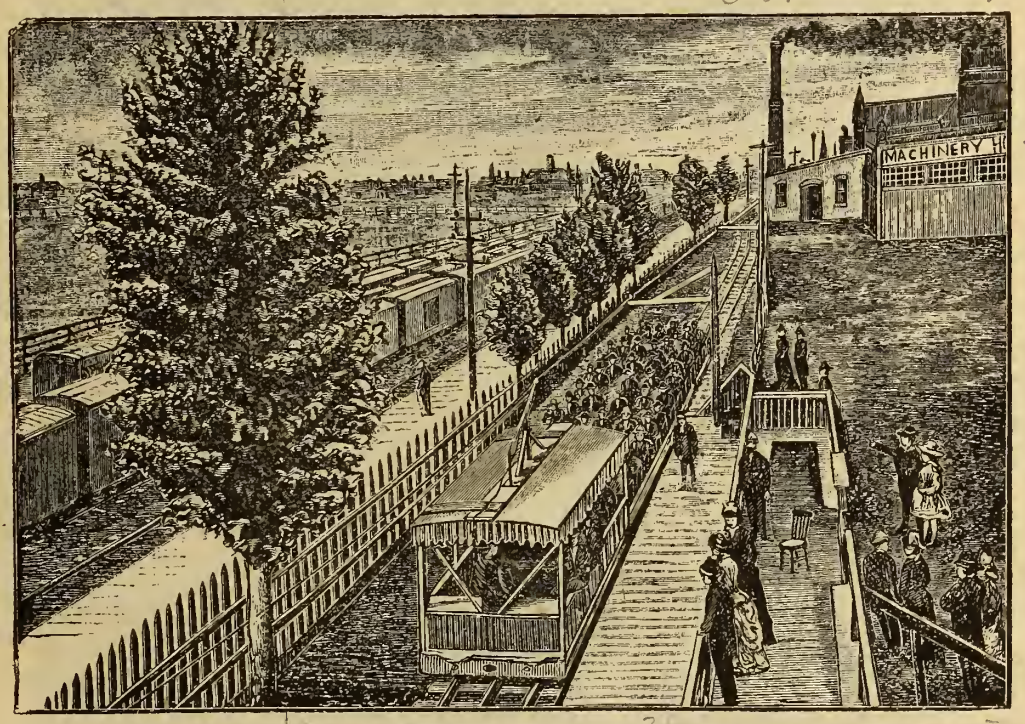
Bros. Pilgrim and Walker expressed their appreciation of the honor and privilege of being placed in a position to work for the interests of the Association. Bro. Ogle having been in office since the inception of No. 4, was praying for a term's rest, but the members think they have the right man in the right place, and therefore have asked him to toil on a while longer. His books are always in good shape and ready for inspection.

Yours truly, STEAM.

The John Doty Engine Co., of Toronto, have just opened a branch of their business at Vancouver, B. C., and have placed in charge of their western interests, Mr. O. P. St. John, late Government Steamboat Inspector at Toronto. The venture having been entrusted to such capable hands, should prove successful.

OUR FIRST ELECTRIC RAILWAY.

CONSIDERABLE interest has always centered on the electrical railway of the Toronto Industrial Exhibition. Not only was it the first electric railway operated in the Dominion of Canada, but it was among the first on the continent. It is also interesting from the fact that devices were first tried on it which have become necessary to the operation of electrical tramways the world over. The first year, 1883, in which the experiment was made, only a short piece of track was laid. The motor, an imitation outwardly of the experimental machine tried at Chicago the year before, did not "mote" to any great extent, owing to the dynamo used on the car being a double armature one with only one pole piece to each armature. The year following, 1884, produced the first practicable road. It was the work of Mr. C. J. Van Depoele, of Chicago, a genial gentleman and clever mechanician, who will be remembered by the pioneers of the electrical business in this province. It would be considered a crude affair as compared with the modern electric car, but it nevertheless "got there," though with the expenditure of a considerable amount of fuel and supplies. The current was taken from copper strips laid in a wooden box between the rails. This answered perfectly as long as the weather was fair and the box dry, but with the first shower of rain the trouble commenced. It was said to be as good as a play to see the astonished "Van" peering over the end of the car at the streak of blue fire a yard long that streamed out from it as it flew down the grade. But he was not beaten by any means. The next season he was to the front with the overhead wire, and the trolley arm, the original of those now used exclusively in railroad work. The track was lengthened, and became in this year for the first time an electrical railroad proper, running for business purposes, and it was largely patronized by the public as the readiest means of reaching the Exhibition grounds. The following years 1886-7-8-9 the road was operated by Mr. J. J. Wright under the auspices of the Toronto Electric Light Company, who built new machinery and otherwise improved the road. The passengers carried frequently numbered as high as twelve to fifteen thousand per day, and it is a noteworthy fact that there never was an accident even of the slightest nature to any person. The nearest approach to anything of the kind was during the year of Van Depoele's conduit, when an inquisitive agriculturist put his hand through the slot in the top of the box to see where the power came from. He made the discovery at once and effectively, but beyond this sudden accession of knowledge he was not hurt. However, it was noticed that he kept considerable real estate between himself and the railroad for the balance of the day. There were during the later years, four cars, each capable of carrying 70 to 75 persons. As these had to be hustled up a grade of considerable extent at a speed of twenty miles an hour or so, and there was only one motor, it can easily be seen that it took a considerable streak of electricity to do the work, and many a tale could be be told of the difficulties that had to be encountered, in all kinds of weather, to keep it within due bound, and hold it down to its work day in and out for sixteen hours at a stretch, and of the expedients resorted to at times to avoid an impending stoppage. But withal, the road was a great success, so much so, that Mr. Wright was made the recipient of a handsome testimonial from the Exhibition authorities in recognition of the fact. We refer to this subject as now, on account of the extension of the street railway to the gates of the park, this historic road has become a thing of the past. The spot where crowds of merry excursionists were wont to flit along the line is to be used as a siding to unload cattle upon. *Sic transit gloria mundi*, but all the same, when the city's tramways are "electricized" and the modern motors achieving their perfect work, there will be in this city those whose thoughts will revert in loving remembrance to the old exhibition road, and the scenes and incidents of its stirring existence. Its grievous sins of omission and of commission, as shown up in the brilliant light of to-day, will be heartily condoned, inasmuch as, with all its faults, it achieved for its sponsors both moral and financial success.



FIRST CANADIAN ELECTRIC RAILWAY.

SANDWICH, WINDSOR AND AMHERSTBURG ELECTRIC RAILWAY.

THE Sandwich, Windsor and Amherstburg Electric Railway, which went into operation a couple of weeks ago, is reported to be working most successfully. In fact, if we are to believe the the statement of a local paper, the citizens are "tickled to death,' over it. We donot understand this to mean that electrocution is getting in its work on them, but simply that they are greatly pleased with the new enterprise.

The people on the Canadian side of the river are now taunting Detroiters with being behind the age, and are enquiring when it is their intention to make an effort to "keep up with the procession."

The motive power used is the Westinghouse overhead trolley system.

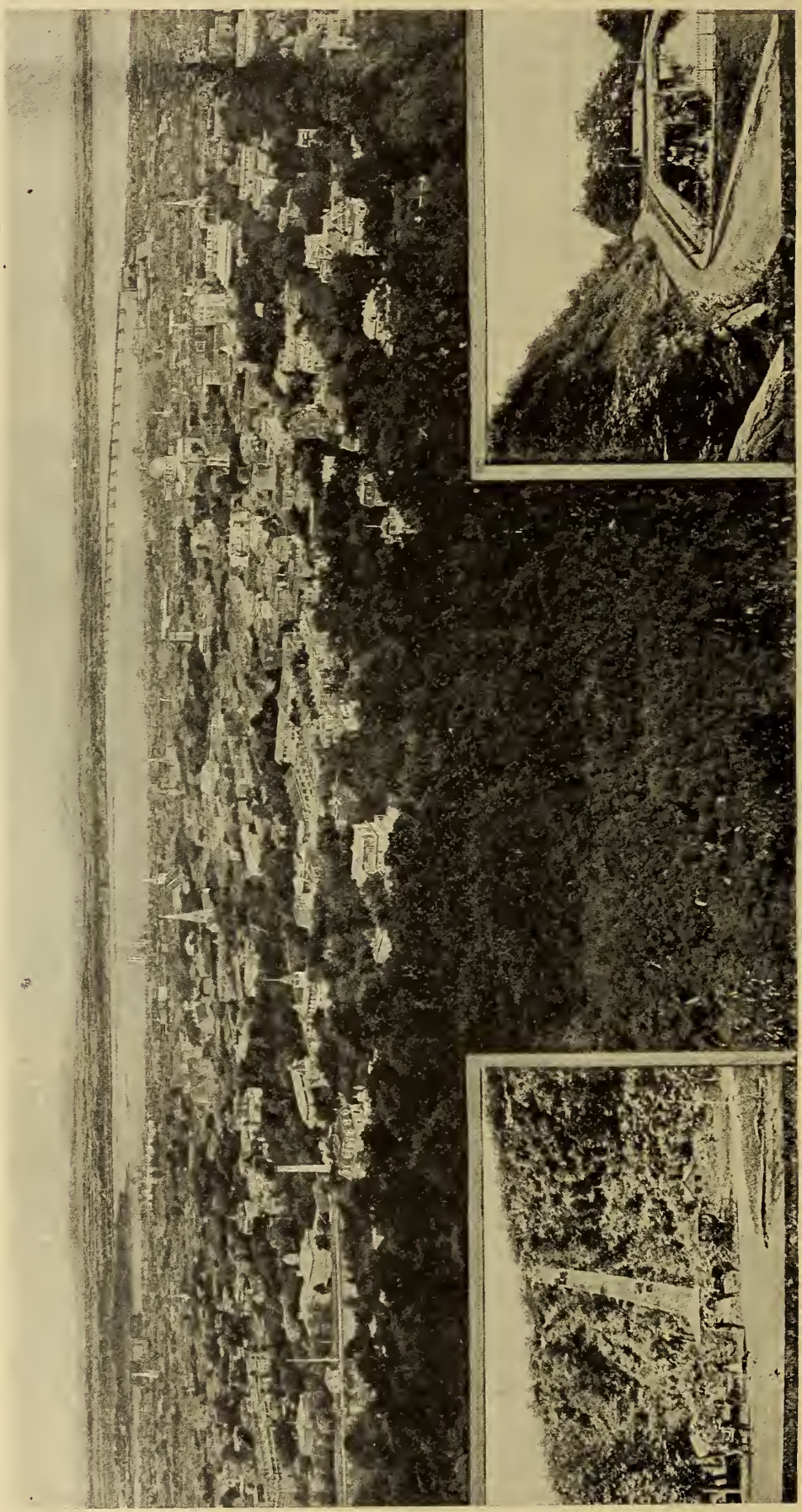
We are pleased to see that the cars on this line are lit by incandescent electric lamps, a new and very desirable feature of electric railway equipment.

PUBLICATIONS.

The Fort Wayne Electric Co. have published a pamphlet entitled "Kind Words," which contains a large number of flattering testimonials to the excellence of the system of electric lighting of which the company are the promoters. We are indebted to Mr. W. J. Morrison, general agent for Canada, for a copy of the book.

The intellectual wealth of three continents is represented in the September *Arena*. The well-known English essayist, F. W. H. Meyer, of Cambridge, England, speaks for European thought in a careful paper on physical work. Kuma Oishi, M.A., of Tokio, Japan, represents Asia in a brilliant paper on the Extrinsic Significance of Constitutional Government in Japan; while such able thinkers as Rabbi Solomon Schindler, Rev. George C. Lorimer, Thomas B. Preston, Sylvester Baxter, and the editor represent America.

A quantity of electrical apparatus imported by the Calkin Electric Light Co., of St. John, N. B., was recently seized by the customs officers of that city on the ground of undervaluation.



BIRD'S EYE VIEW OF THE CITY OF MONTREAL.

THE NATIONAL ELECTRIC LIGHT ASSOCIATION OF THE UNITED STATES.

PROGRAMME OF THE MONTREAL MEETING, SEPTEMBER, 1891.

Session to open at 10 a.m., and adjourn at 2 p.m.

SEPTEMBER 7TH.—3 p.m.—Convention called to order; addresses of welcome and reception; response; address of president; report of secretary; report of treasurer; reading invitations received; adjournment to meet in evening at Exhibition Rink at 8 o'clock p.m. 8 p.m.—Formal opening of the exhibition.

SEPTEMBER 8TH.—Reports of Committees on Relations of Manufacturing and Central Station Companies, etc.; Reports of Committees on Data; Reports of Committees on World's Fair; Reports of Committees on Legislation; Reports of Committees on Underground; Reports of Committees on Safe Wiring.

SEPTEMBER 9TH.—Discussion of T. C. Smith's Paper; Paper—W. C. Warner, "Various Forms of Carbon for Use in Arc Lamps"; Paper—Capt. Eugene Griffin, "Three Years Development of Electric Railways"; Paper—H. Ward Leonard, "A Central Station Combining the Advantages of both Continuous and Alternating Systems."

SEPTEMBER 10TH.—Paper—J. I. Ayer, "Some Details of the Care and Management of an Arc Lighting Station, as Practised in the Municipality of St. Louis"; Paper—C. J. Field; Paper—George A. Redman, "Central Station by Water Power"; Paper—J. J. Burleigh, "Uniformity of Method in Keeping Central Station Accounts."

Executive Session to follow immediately to elect members of Executive Committee, and to name place of next meeting.

Entertainments to be arranged for each day and announced by bulletin.

The following is the the programme arranged for the entertainment of the National Electric Light Association of the United States, by the Citizens' Executive Committee, Montreal:

MONDAY, SEPT. 7th.—Opening proceedings of the Convention in the Windsor Hotel, addresses of welcome by His Worship the Mayor, and other distinguished members of the Reception Committee. 3 p. m.—Formal opening of the Exhibition.

TUESDAY, SEPT. 8th.—2.30 p. m.—Fire Department Display on Champs de Mars. 4 to 7 p. m.—Garden Party. 8 to 11.30 p.m.—Conversazione at Redpath Museum, Molson Hall, McCill University.

WEDNESDAY, SEPT. 9th.—3 p.m.—Drive through the city and around the mountain. 4 to 7 p.m.—Garden Party.

THURSDAY, SEPT. 10th.—2.30 p.m.—Through the kindness of the Harbor Commissioners, trip by boat down the St. Lawrence and the Lachine Rapids, stopping on the way at Caughnawaga. 8 p.m.—Banquet at the Windsor Hotel.

FRIDAY, SEPT. 11th.—3 p. m. — Lacrosse match, Garden Party. In the evening Promenade Concert at Sohmer Park, through the courtesy of Messrs. Lavange and Lajole.

SATURDAY, SEPT. 12.—3 p.m.—Yachting excursions for ladies, on the St. Lawrence and Richelieu rivers. 7. p.m.—Excursion to Quebec at reduced rates.

It is expected that His Excellency the Governor-General will be present during the Convention.

A REPLY TO "R."

TORONTO, Aug. 17, 1891.

Editor ELECTRICAL NEWS.

DEAR SIR,—Allow me to say in answer to a letter signed "R" in last month's NEWS, that, judging him by his letter, he does indeed (as you say) show a little of that intolerance which he so unsparingly condemns in others.

As regards the explosion on Dufferin street, I can only say that if the particulars of the case were as "R" reports them, no blame could possibly be attached to the engineer in charge, and the letter which I wrote to your paper would in that case be doing him an injustice, and as I never (to my knowledge) saw the man in my life and have no idea who he is, I would be the last man to do him an injury intentionally.

On the other hand, the information I received on the subject and the source of same (in the absence of further proof of "R's" statement), I consider equally reliable. "R" should not talk of "venting spleen," &c., as it is very easy to see after reading his letter in the NEWS that he is venting his spleen against, and showing his hatred for, the C.A.S.E. I may say that I am a member of the Association, and am proud of it, too; for it has done me more good than any other organization I ever became a member of, and if "R" is an engineer (but I feel sure he is'nt), I can assure him it will do him all the good imaginable to become a member of the "ring," as he calls it.

It would not be a hard matter to take the wind out of "R's" sails on one or two points in his letter, but I do not consider it is worth while, as it might only give him a chance to again open his tirade of jealousy and slander against an organization that is honestly striving to do a good work in raising by all legitimate means the status of the stationary engineers of Canada, and which has up to the present time met with a fair measure of success in its undertaking.

We invite our employers, the steam users, to unite with us and even attend our meetings, feeling satisfied to leave the verdict in their hands as to whether or not the objects of the Association are such as should command the respect and esteem of our fellow citizens. We have no fear of the result.

The latter part of "R's" letter I will leave to the tender mercy of "S" (whoever he may be), although I see that "R" gives in his wisdom one writer the credit for both letters. In this guess he is far astray.

Apologizing for taking up so much of your space, and wishing the NEWS the success it so well deserves, I remain,

Yours, &c.,

SAFETY.

SAFETY VALVES, THEIR HISTORY, ETC.

611 & 612 Electrical Exchange.

NEW YORK, 12th August, 1891.

Editor ELECTRICAL NEWS.

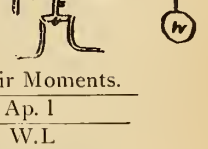
It is with some hesitation that criticism is offered upon Mr. Le Van's articles upon safety valves, begun in your paper vol. 1, No. 7, p. 88, issue of July, '91. The following points are noted that no beginner may be accidentally led astray:

Throughout the article appears the term "static momentums" where it is usual to use the term "static or statical moment," (see Weisbach "Theoretical Mechanics," p. 195)—the word momentums or quantity of motion belonging to that part of mechanics treated under the head of dynamics rather than under statics when the lever is rightly put.

Instead of saying: "The resistance at *f* is called the fulcrum," would it not be more accurate to say that the fulcrum is the point of application of a third force about which two other forces or sets of forces are being balanced, the axis or point about which rotation or equilibrium is established being defined as the fulcrum (Weisbach, p. 255, or D. K. Clark's "Manual of Rules, &c.," 5th edition, 1890, p. 296; "Kinematics and Dynamics"—J. G. Macgregor, 1887, p. 406, &c.

Going into it a bit deeper, the fulcrum is really the "permanent centre" of the lever, ("Mechanics of Machinery," A. B. W. Kennedy, 1886, p. 47.)

On p. 106 it is correctly stated that "there are three levers," but it is incorrect to say that the weights act only at two different points. The general equation (1) W.L+w x=A.p.l. is incomplete. The "moments" (not momentums) of the form forces involved are as follows: The weight of v+3=2



Forces.	Their Lever Arms.	Their Moments.
A.p.	l	Ap. l
W	L	W.L
w	x	w. x
Z	l	Z.l

making the general equation :—

Apl=W L+w x+z l

The weight of the valve and stem act with the arm l, not with the arm x, and ∴ it is incorrect to add the weights v, s and w, and take their sum as a force acting with the arm w. This mistake may be due to an article in *Power-Steam*, vol. X, No. 5, p. 6, May, 1890, where the error likewise occurs.

Yours truly,

J. STANFORD BROWN,

Consulting Engineer.

The famous Crocker-Wheeler Perfected electric motors are having an immense sale. The Crocker-Wheeler Electric Motor Company, N.Y., U. S.A., sole manufacturers, find it impossible to keep up with the demand, though they have recently enlarged their shops and otherwise increased their manufacturing facilities. These motors are made without regard to cost of material or labor, and are so designed that they do the regular rated work at a much slower speed than has been possible before. They are said to be acknowledged by leading electrical engineers, dealers and manufacturers to be the most perfect, efficient, best proportioned, most reliable, and best looking motors made.

Visitors to the convention who may be passing through Toronto should, if possible, stop oft long enough to take a look at the city and visit the electric lighting station on the water front. The works of the Toronto Electric Light Company are always open to the public and they will be especially so to the members of the convention. This station occupies a somewhat unique position inasmuch as all their plant is manufactured on the premises. They have a well-equipped machine shop, including winders and braiders for covering all the wire used for line work and dynamos. There is no secretiveness about the policy of the management, and many devices originating here have been adopted by other electric light companies througout the country, notably an automatic cut-out for use on lamp poles to prevent open circuits through breaking of leading wires. They are nothing if not original, and visitors could no doubt be able to pick up pointers that might be of great use to them in the business. There are lightning arresters on each line which are contained in a separate building, so avoiding any chance of fire in the main building through an accidental short circuit in the arrester; and they have a very complete apparatus in connection with the fire alarm service of the city, enabling their patrolman with horse and wagon to start out within ten seconds of the striking of the alarm in case his services should be needed to look after the safety of any of the lines. We are assured that visitors to the works of the company will be made most welcome.

JNO. C. FERGUSON.

By "Proctor."

The announcement in the evening papers of Thursday, Aug. 20th, that J. C. Ferguson, Chief Engineer of the Toronto waterworks was dead, came to his large circle of mechanical friends with all the soreness of a personal bereavement.

It was known to some of them that he had been unwell—to a few that he was very ill—but to the great majority who had heard nothing of his indisposition (and who knew of his anxiety to have everything right, and his close attention to his duties, and were therefore not surprised at not seeing him on the streets occasionally), it was quite an unexpected paragraph.

I have known him both as a mechanic, a student, and a Christian gentleman for upwards of twelve years past, and I deem it due to your readers—and especially the younger men with aspirations—that I should give a few "points" out of his life history.

I write under my old *nom de plume* because it brings back to me pleasant memories of the times when he used to criticize my "Proctor's Points," and take great delight in pleasantly disputing my theories.

To mechanics who were not personally acquainted with him, it was a matter of some surprise that he came out at "the head" in the crucial examination through which the applicants for the position of waterworks engineer had to pass in 1887, but to some of us who knew him as a careful, critical student in mechanical matters, as an engineer who accepted no theory or method unless it would bear the fullest investigation, who knew that, in his own way, his head was well stored and skillful with facts, figures and formulas, as his hands were expert in fitting, it was no surprise that he demonstrated his ability to fill the position.

His close attention to the duties and obligations of the engineership, his almost morbidly conscientious anxiety, lest by any slip on his part there should be a failure in the city's water supply, and the watchful care required both day and night, were just a little too great a burden for him. This burden was added to when, lacking the assistance of his assistant, Mr. Kilby—who is now soon to follow him—some stupid bungling fellows drove a spile through the intake pipe at the island, and let a flood of sand into it that day after day was slowly but surely grinding the cylinders and pistons of his pumps, so that they at last were not capable of doing much more than half duty.



The Late John C. Ferguson.

Just at this time, too, with all this burden and anxiety upon him, some "Daniel come to judgment," seeking for a kind of fish-wife notoriety by fault-finding, in the press and at the council board, said a number of things that seemed to reflect on his department, every word of which, though entirely undeserved, hurt him like the sting of a Russian knout, and he simply broke down under the combined pressure.

It was hoped that a few months rest might restore him to usual vigor, but he came home two months ago after a two months absence only to find himself unable to give any further attention to his duties, and went to his quiet home to die, as he had lived, a true man.

I remember the first time I saw him. In the winter of '78, I think, passing through one of our city machine shops in a leisurely way, looking at the men at work, I noticed a tall, well-built, athletic workman, chipping on a machine casting. The man himself attracted me first—he was working as if he meant to get his job done on time. But the swing of that hammer! I never saw but one other man who could swing a chipping hammer with John Ferguson. On the occasion referred to I remarked to the owner of the shop that he had one first-class hand upstairs. "Oh, yes," said he, "but I pay him good wages." "How much?" "$3.50 per day; but," he added, "he's worth it." Ordinary vise hands were worth $1.75 to $2.00 a day.

In those days he engineered on a lake steamer in the summer and wrought as a journeyman machinist in the winter. Every spare moment was spent in study. Line after line was taken up and gone into as thoroughly as if it were an absolute necessity that he should master both elementary principles and mechanical construction—hydraulics, steam engineering, bridge work, machine building, marine work, etc., etc.

It became fully known, early in the "eighties," that anything he did was done well, and he always had a choice of situations. The only reason why he did not attain to special prominence was simply the lack of any important mechanical enterprises in Canada. His remodelling of the large pumping plant, and the complete efficiency obtained, justified the confidence of his friends in his mechanical ability.

He was always gentle, quiet and reserved in his intercourse with others; and whether as journeyman or master mechanic, kind, considerate and helpful to all around him. In his personal and private life he was ever—since I have known him—a consistent, earnest Christian. Reticent almost to a fault sometimes, it is yet true that he spoke very freely to those who came in heart-touch with him, of religious matters. No man could buy or sell him. He lived above the petty ambition of private gain out of public relationships. I well remember the indignant scorn which flashed in his face as he told me of some fellow who—not knowing him—offered to pay him a commission on all the goods he sold to the city, if he would recommend the goods. I interrupted him in his narration by interjecting the question:—"*What did you tell him, John?*" "Tell him," said he, straightening up, "I fired him out of the office!"

Just passing out of his manhood's prime, sooner than some of us, he has entered that other and higher realm where force hath origin, where system and order have their source, where law is eternal, and life and being but the pulsing of the Infinite.

Not the *dying* but the *living* with its trusting,—
With its motives, broad and ample, and its purpose strong and deep—
Measures up the worth of being. All adjusting
Is with One who knows the balance and doth righteous record keep.

Every beating brain and throbbing heart are factors
In the mystic revelations of the hidden and unknown,
And each toiling hand is helper. But the "Actors"—
Never thinking, loving, doing—live for self and earthalone.

They who *knock* at Wisdom's portals, in rogation,
Have the promise, she will "open" and reveal her golden prime,
And, no doubt, it will, to crown each aspiration,
Take Eternity to answer all the questionings of Time.

Every action with a motive hath its promise
Of eternal bane or blessing as its ultimate reward;
Let us (fearing, lest our good be taken from us)
See that every thought and purpose clearly glorifies the Lord.

To God's Acre, where nor fear nor care molesteth,
We resign the pulseless mortal, of life's sentient forces shorn:
He was true and so we leave him where he resteth,
Whence the Christ—"The Truth"—will call him on the Resurrection Morn.

THE C. A. S. E.

Toronto, Aug. 10, 1891.

Editor Electrical News.

Sir,—When looking over the correspondence in the last issue of the News, I noticed in a letter signed "R" a question is put to me as President of the C.A.S.E., as to whether any engineer was ever refused admission to the Association for lack of the necessary qualifications, or, as "R" puts it, because he did not know enough.

In answer, allow me to inform "R" that several engineers have been refused admission for lack of the necessary qualifications as engineers, therefore he is not stating facts when he asserts that all who have applied have been admitted. I would also remind "R" that the Association is no exclusive ring. Any engineer who is sober, steady and of good moral character, and who can satisfy the examining committee that he has the practical experience which the by-laws provide for, can become a member; and after going this far, if he regularly attends the meetings and has any ambition at all, he will certainly find that he has considerably improved himself as an engineer, and will ultimately find himself in a better position. There are many engineers in the city of Toronto to-day who from personal experience can bear me out in the above statement. The writer himself speaks from experience on this point.

The chief object of the Association is to unite engineers in a body for mutual improvement and instruction, and to help each other along in our journey through life. We know there are many engineers who have not as yet identified themselves with the Association, and who would, both as engineers and citizens, be a credit to any organization. For these gentlemen we have nothing but the best feeling, and extend to them at all times a cordial invitation to "come with us."

I think it most unfair for "R" or any other person to use such language as he employs towards a body of men who, to say the least, are his equals both as men and citizens, just because one of their number, according to his idea, rushes into print with something which the facts of the case do not warrant.

I presume every institution for a good cause has had and always will have some enemies; therefore we should not expect to be an exception to the rule, but the C.A.S.E. has come to stay, and will get there, too, as long as its motto is "Excelsior."

I remain, yours &c.,

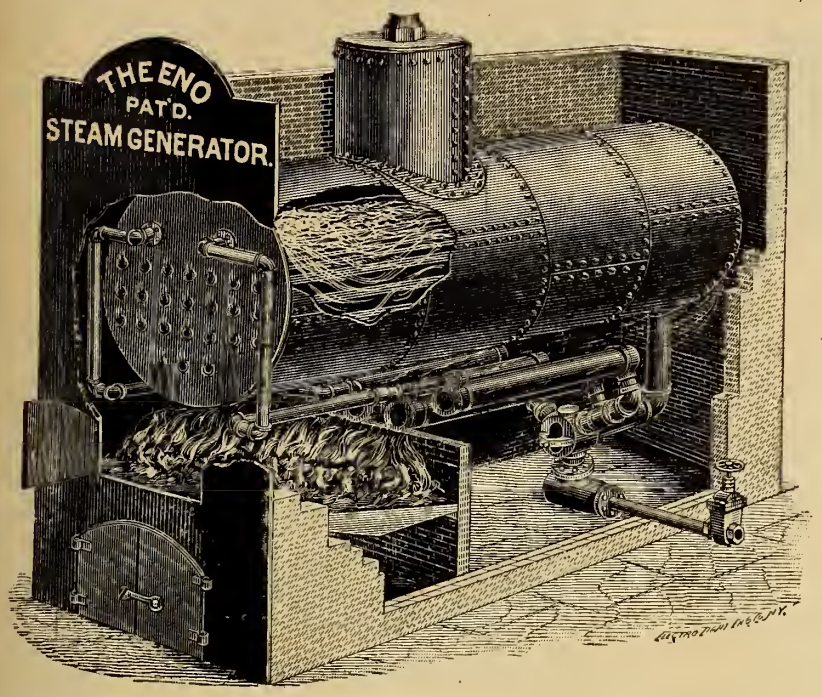
Albert E. Edkins,
President No. 1, C.A.S.E.

22 Agnes St.

THE ENO STEAM GENERATOR.

THE accompanying cuts represent one of the most important and economic steam appliances of the present day, and one that every manufacturer and steam user must ultimately adopt if he would hold the field against his competitors in first cost of production.

This invention accomplishes for steam users all that has been vainly sought in the past, and secures at small additional cost the following demonstrated advantages, viz.; A very rapid and economical generator of steam; a large increase in the quantity of the steam produced; a rapid,



positive and continuous circulation of the water in the boiler and generator, preventing foaming and priming; the separation and removal of sedimentary matter; the increased durability and safety of the boiler; a large reduction in the quantity of fuel required; a saving of from 15 to 30 per cent. in the cost of coal consumed or steam produced is guaranteed by the company.

This apparatus is simple, strong, durable and easily applied to any boiler, being connected therewith by one pipe only at the rear and two at the front, and does not require removal of masonry, and can be applied in from 15 to 30 hours. It is perfectly automatic in its operation, and requires no attention. It has no valves to get out of order, and no coils or return pipes to clog and obstruct the circulation, but both the water and steam always flow in a direct, continuous and constant current.

The accompanying cuts show the generator underneath the boiler and its connection therewith.

The generator proper consists of a series of pipe flues, numbering from 2 or more, according to size of boiler, or results required. Each flue is composed of an inner and outer tube, thus containing a water space between them that is always charged with the water of the boiler. These flues commence at the front of the bridge wall, and extend rearwards therefrom (as per cuts), thereby offering no obstruction to the direct action of the fire on the crown plate or other parts of the boiler. It will readily be seen that the apparatus gives the boiler a large additional fire surface (120 square feet, or more, according to size of boiler or result required), with only a very small additional amount of water. It keeps constantly in the fire a sheet of water over 6 feet square and only ⅝ of an inch thick, with both sides exposed to the fire, thereby converting the water into steam with marvelous rapidity, as well as causing an immense circulation.

The flames and heated gases, when leaving the fire box, pass through the inner tubes and also surround and envelop the outer ones, thereby converting the contained water into steam with the utmost rapidity, and least expenditure of heat.

The water through the pipe in the rear of the boiler flows in a steady current, into and through the tubes, re-entering the boiler as water and steam, through the two pipes at the front, maintaining thereby a continuous circulation of the water through both boiler and generator, largely preventing the formation of scale, and wonderfully increasing the efficiency as well as the durability of the boiler.

As a large quantity of the steam is formed in the flues of the generator instead of in the bottom of the boiler, it does not have to ascend through the water after its formation, but passes onward through the tubes in the fire chamber, where its heat is still further increased, thereby producing a pure, dry steam, instead of the saturated compound obtained from boilers by the ordinary process.

The rapid and continuous circulation of the water and steam, and the removal of the sedimentary matter therefrom, can at any time be witnessed at their factory, where they have a boiler with the top cut out and a generator attached, with glass connections, plainly showing the agitation and circulation of the water within the boiler and generator, also the separation of the sediment therefrom. The circulation and commotion of the water in the boiler is thereby revealed to the eye and is much greater than that portrayed in the cut.

The application of this generator to boilers in daily use has demonstrated that its employment will save from 20 to 30 per cent. of the fuel, or with the use of the same quantity of fuel will increase the amount of steam produced from 30 to 40 per cent. while the time heretofore required to raise the steam to its full pressure is thereby reduced one-half to two-thirds.

They court the most rigid examination of the generator and of all the claims made in its behalf, and are prepared to furnish abundant proof of every statement put forth, to the satisfaction of any candid investigator.

Patents for this invention have been secured in Canada, the United States and all principal foreign countries.

WHAT THE PEOPLE SAY:

They more than fulfilled all your claims for them. We were able to do with two boilers the same work that required three previous to attachment. They also clean the boilers of scale and dirt.
GEO. YORKE,
Engineer for Ontario Government, Osgoode Hall, Toronto.

It has given perfect satisfaction, saving 15 to 2 per cent. in coal bill, giving at same time an increased steam capacity sufficient to heat a building 27 x 90 feet, five stories.
THE CROMPTON CORSET CO., Toronto.

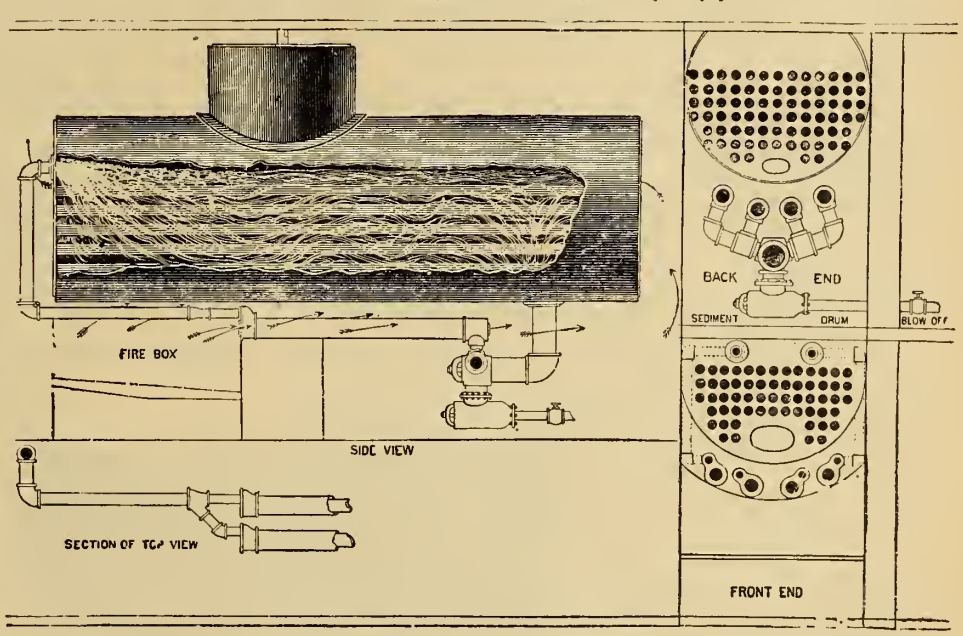
We have a second boiler nearly built in and want to put on another of your Generators. How soon can you have one ready to put on? We would like it this week if possible and same as one already on Let us hear from you by wire upon receipt of this.
THE R. FORBES WOOLEN CO., Hespeler, Ont.

Enclosed we beg to hand you bank draft for Generator attached May 15th. The Eddy Co. express themselves highly satisfied with them, and will require more of them soon.
McKINLEY & NORTHWOOD,
For the E. B. Eddy Mfg. Co., Hull. P. Q.

Your Generator when tested six months ago was saving between 20 and 25%. It is saving more now, having removed old scale from boiler.
R. WHITELAW, Engine and Boiler Mfr., Woodstock, Ont.

Please ship and attach to our boiler No 3, another of your Steam Generators. Price, terms and conditions same as former contract.
FERGUSON & PATTINSON, Woolen Mfrs., Preston, Ont.

We now take pleaure in enclosing our cheque in payment of two Steam Generators



now on our boilers. We are now ready to have the third Steam Generator put on our other boiler. Please let us know when you can make the attachment.
THE WATERLOO (ONT.) WOOLEN MFG. CO.

We were short of steam, but now we have plenty. At the same time we are burning over 500 lbs. of coal per day less than previously. It is keeping the boilers clean, old scale being removed by the rapid circulation, and the labor in firing greatly reduced.
LANGLEY & BURKE, Trustees Burke Estate, Toronto.

In addition to the many Generators already in use, contracts are now in course of completion for The Dominion Cotton Mills Co., Montreal; The Ontario Cotton Co., Hamilton; The E. & C. Gurney Co., Toronto; The Carling Brewing & Malting Co., London; The Toronto Board of Trade; The E. B. Eddy Mfg. Co., Hull, Quebec; Laval University, Quebec, P.Q, and others.

For free illustrated book, estimates, and full particulars, address The Eno Steam Generator Co., (Ltd.), 7 Richmond Street West, Toronto, Ont.

MY DEARIE O!

(Written on Boston & Maine Railway, April, 1889.)

My Love, 'tis joy for me to know—
While sunlight streams so cheerie, O—
That every happy mile I go
Is so much towards my dearie, O.
And though the fields of Maine are bare,
And vernal breezes 'eerie, O,—
In "Baldwin's bowers" "*The Elms*" are fair,
And 'neath them is my Dearie, O.

I've been a roamer many a day
In lands where all were strangers, O;
I've been exposed in many a way
To countless ills and dangers, O;
I've made new friends and bow'd farewell
Till all my soul is weary, O.
Now, every ringing engine bell
Sings:—"Going home to Dearie, O."

I've found some hearts that beat with mine
In love's divinest measure, O;
I've seen some eyes—confiding—shine
With trust I long shall treasure, O,—
But not an eye could beam so bright—
Or win a flame so cheerie, O,
As her's (whose glance is beauty's light)—
I joy to call "*My Dearie, O.*"

I've seen Acadia's rugged hills,—
Breathed Bay of Fundy's breezes, O;
Praized Kenne'casis' rippling rills,
Where Hampton's hillside pleases, O;
But fair Ontario suits me best,—
Nor why, need no one query, O,—
In her "Queen City of the West"
"*The Elms*" protect My Dearie, O.

LLEWELLYN A. MORRISON.

[We asked Mr. Morrison for an electrical contribution. He sent us the above with the remark that *light* and *power* were electrical productions sometimes, and it was easily discernible that this was a *light* contribution, but he doesn't think that many of the electricians can measure the "voltage."—ED.]

TRADE NOTES.

We would call the attention of the delegates to the Electrical Convention, to the Balmoral Hotel. The accommodations are first-class, location central, and under its present management it is enjoying a reputation that is second to none in Canada, and the rates are reasonable.

Messrs. Chas. A. Schieren & Co., New York, U.S.A., find the demand for their patent perforated electric leather belting increasing right along. For use on dynamos and other swift running machinery it is claimed to be unequalled. One of these belts is illustrated in our advertising columns in this issue.

Electricians visiting Montreal will find central and in every way desirable quarters at the Turkish Bath Hotel on St. Monique Street, not far from the Windsor. This large hotel is a high class temperance house, with the conveniences and comforts of all first-class hotels, while the charges are moderate. F. E. McKyes, manager, is always glad to answer inquiries.

If you want a satisfactory insulated wire or cable, either for aerial, underground or submarine use, get the Okonite, manufactured by the International Okonite Company, (Ltd.), New York and London. These goods are known all over the world for their many superior qualities and have received the endorsement of the most prominent electrical experts and electricians.

A most important factor in the operation of every central station successfully, is a good boiler feed pump. The "Davidson," manufactured by M. T. Davidson, Brooklyn, N.Y., U.S.A., is claimed to be the simplest, most durable and efficient pump made. It is certainly very popular with the electrical fraternity, and a large number of them are in use throughout the States for central station work.

The attention of our readers is directed to the advertisement of Mr. John Starr, of Halifax, Nova Scotia, appearing for the first time in this number of the ELECTRICAL NEWS. Mr. Starr is the general Canadian agent for the sale of the Lahmeyer incandescent light dynamo for municipal, factory and residence lighting. Mr. Starr has received strong testimonials regarding the efficiency and economy of these dynamos from the judges of the American Institute Fair, Messrs. Henderson & Potts, of Halifax, the superintendent of the Halifax Protestant Industrial School, and others.

One of the busiest electrical manufacturing establishments in the city of Newark, N.J., U.S.A., is that of the Weston Electrical Instrument Co., manufacturers of the Weston direct-reading voltmeters and ammeters for direct current circuits. All persons engaged in the electrical business and others having occasion to make accurate electrical measurements should investigate the merits of these instruments. Neither trouble nor expense has been spared to make them perfect in every detail. They have been adopted as standard instruments by nearly every company engaged in the manufacture and sale of electrical machinery.

It is rapidly becoming the custom for firms in the United States, who use the industrial press extensively, to pass their favors through special agents about the same as they do their insurance. Many large and influential firms in the electrical line thus enjoy the experience and privileges of the Manufacturers' Advertising Bureau and Press Agency, conducted by Benj. R. Western, 111 Liberty street, New York, U.S.A., and find their work not only well and conscientiously done, but secure many advantages that no single concern could hope to obtain of itself. We take pleasure in recommending Mr. Western to the consideration of our friends.

Messrs. A. Holden & Co., of Montreal, are the sole agents in the Canadian provinces for the Goubert "Water-Tube" feed water heater, claimed by the Goubert Manufacturing Company, New York, U.S., sole manufacturers, to be the only heater in the market meeting the requirements of high pressure, free exhaust, high efficiency and great durability under all conditions. It is extremely popular with steam users in the States, and we notice is attracting considerable attention from Canadian manufacturers and others who wish to produce steam economically. Messrs. A. Holden & Co. will gladly give our readers full information regarding the merits of this heater upon application.

The following is a list of plants sold by the Edison Company since June 15th:—Merrickville Ont., Electric Lt. Co., capacity 420 16 c.p. lamps; C. Saurman, Paris, Ont., 150 16 c.p.; Palmer & Paul, Carberry, Man., 270 16 c.p.; Belding, Paul & Co., Montreal, 900 16 c.p.; A. W. Parker & Son, Lindsay, Ont., 420 16 c.p.; Gananoque Electric Lt. Co., 720 incandescent; Temple Electric Co., Montreal (increase), 1080 16 c.p.; Steamer North King, Kingston, Ont., 110 16 c.p.; *Gazette* Print Co., Montreal (increase), 1080 16 c.p.; B. R. Mowbry & Son, Gravenhurst, 30 16 c.p.; S. T. Willett, Chambly, Que., 560 16 c.p.; Nicholls Chemical Co., Capleton, Que., 210 16 c.p.; Edison Electrical L. & P. Co., Sydney, C.B., 720 16 c.p.; James Corristine, Montreal (increase), 90 16 c.p.; Heath, Tait & Turnbull, Huntsville, Ont., 30 16 c.p.; R. Forbes & Co., Hespeler, 420 16 c.p.; John Campbell, St. Thomas, 35 16 c.p.; N. D. McDonald, Winnipeg, ¼ h.p. motor; Dominion Express Co, Montreal, 2 ½-h.p.; Dominion Bank Toronto, 1 3-h.p. and 1 ½-h.p.; Temple Electric Co., Montreal, 2 10-h.p.; McGill University, Montreal, 2 ½-h.p. and 1 10-h.p.; James Corristine & Co., Montreal, 1 10-h.p. and 1 6-h.p.; Davidson, McFarlane & Co., Montreal, 1 6-h.p.; Singer Mfg. Co., Montreal, 1 1½-h.p.; Walkerville Malleable Iron Co., 150 16 c.p. and 6 arc lamps; Montreal Elevated Ry. Co., an electric railway 5 miles in length with 100 h.p. generators and 6 cars fully equipped; Metropolitan Street Ry., 1 electric car fully equipped. Besides the above the Toronto Incandescent Company have put in a large number of Edison motors and additional apparatus.

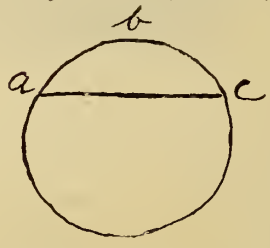
EXHIBITORS AT THE MONTREAL CONVENTION.

UP to the time of going to press the list of firms who will exhibit at the approaching Montreal Convention, was as follows:

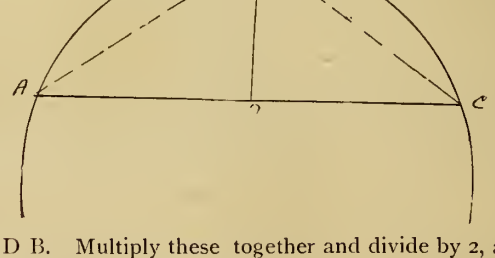
Eureka Tempered Copper Co.,	North East, Pa,
Chas. A. Schieren & Co.,	43 Ferry St., New York.
New York Insulated Wire Co.,	649 Broadway, do
Standard Underground Cable Co.,	18 Times Bldg., do
W. J. Johnston Co., Ltd.,	167 Times Bldg. do
Standard Electrical Time Co.,	New Haven, Conn.
Standard Paint Co.,	3 Liberty St., New York.
Fort Wayne Electric Co.,	Fort Wayne, Ind.
Electrical Engineering & Supply Co.,	Syracuse, N. Y.
Eugene Phillips Electrical Works, Ltd.,	Montreal, Can.
Felton & Guilleaume, c/o Middleton & Meredith,	Montreal, Can.
International Okonite Co.,	13 Park Row, New York.
Weston Electrical Instrument Co.,	Newark, N. J.
The John Pratt Co.,	Hartford, Conn.
The Ball Electric Light Co.,	Ltd., Toronto.
Electrical Engineer	150 Broadway, New York.
Interior Conduit & Insurance Co.,	42 Broad St., New York.
R. Mitchell & Co.,	Montreal.
Thomson-Houston International Electric Co.,	Boston, Mass.
Toronto Construction & Electrical Supply Co.,	Toronto.
H. Ward Leonard & Co.,	42 Broad St., New York.
Dominion Wire Manufacturing Co.,	Montreal.
T. W. Ness,	Montreal.
Edison General Electric Co.,	77 Bay St., Toronto.
Norwich Insulator Wire Co.,	58 Cedar St., New York.
Excelsior Electric Co.,	Boston.
Canadian Electrical Construction & Supply Co.,	Montreal.
Russell Electric Co.,	Boston.
Electric Power,	150 Liberty St., New York.
McGill University,	Montreal.
Hart & Hegeford Mfg. Co.,	190 Pearl St., Hartford, C.
M. E. Dansereau,	32 St. James St., Montreal.
The Connecticut Motor Co.,	Plattsville, Conn.
John Fitzgerald,	Montreal.
The E. S. Greeley Co.,	5 & 7 Dey St., New York.
The Jewell Belting Co.,	Hartford, Conn.
The La Boilleaux Electric Motor Fan Co.,	Cincinatti.
Delaware Hard Fibre Co.,	Wilmington, Del.
Phœnix Glass Co.,	729 Broadway, New York.
Germania Electric Co.,	Boston, Mass.
Electric Review,	New York.

QUESTIONS AND ANSWERS.

E. J. PHILLIPS, Toronto, asks: How can I find the area of the part of head of a boiler that has to be stayed? Or the area of a part of a circle (such as a, b, c)?



ANS.—To calculate exactly the area of the segment of the circle a, b, c, is rather difficult for ordinary every day work. Tables are published in some mathematical works giving the area of segments of all sizes up to half circle, assuming the diameter of circle to be 1". For the purpose of determining the size of boiler stays, however, it will be found sufficiently accurate to measure the length of the line A C along the top row of tubes, and the



height D B. Multiply these together and divide by 2, and the result is the area of the triangle A B C. As the tubes and the shell take a share of the strain upon the boiler head, the area of the triangle is a fair amount to reckon as having to be supported by the stays.

THE SMALLEST STEAM ENGINE.

THROUGH the kindness of the inventor, Mr. Thos. Ticknor, of Parkhill, Ont., we are enabled to present to our readers an illustration, reproduced from a photograph, of the smallest steam engine in existence. Mr. Ticknor has succeeded after years of labor in completing this marvel of mechanical ingenuity. The "Little Jumbo," as this miniature contrivance is designated, is a perfect model of a steam engine, complete in every detail, and works with the accuracy and ease of a Corliss, and performs in miniature the same work as the most massive engine ever constructed. Its dimensions are as follows : Diameter of cylinder, ⅓ of 1-16th of an inch ; stroke, 1-32 of an inch ; weight, ½ of



THE "LITTLE JUMBO" ENGINE.

a grain ; bore of cylinder, .3125 of square inch ; revolution, .1760 per minute ; horse power, .12490 part of a horse power.

It is so small that it can easily be covered with the case of a 22 calibre cartridge, being two-thirds smaller than the famous Waterbury engine that attracted so much attention at the Centennial.

IMPORTANT NOTICE.

A meeting to informally consider the advisability of organizing a Canadian Electrical Association, will be held on Thursday, the 17th Sept., inst., at the hour of 2.30 o'clock p.m., in the offices of the Industrial Exhibition Association, Exhibition Grounds, Toronto. A cordial invitation is given to persons in any way interested in the electrical industry in Canada, to be present.

GARLOCK'S ELASTIC RING PACKING.

This packing, illustrated by the accompanying engravings, was patented and first manufactured by Orrin J. Garlock, at Palmyra, N. Y., about six years ago. The main offices and factories in connection with its manufacture are located at Palmyra, N. Y.; Rome, Ga.; and Hamilton, Ont. The Canadian factory was started about three years ago.

From very small beginnings the manufacture of this article



SPIRAL.



SECTIONAL RING.



ELASTIC RING.

has grown to such an extent that upwards of 200 employees are now at work in the various establishments. The material is said to be in use in 28,000 engine rooms in the United States and 2,000 in Canada.

It is made in rings a perfect fit to the rod and box. The sectional ring packing is especially adapted to rods out of line, cut rods, flat bottom stuffing boxes and places that are very difficult to keep tight. The Garlock Packing Co., of Hamilton, who are the Canadian manufacturers, state that they are almost daily in receipt of letters from consumers highly recommending the packing.

PERSONAL.

Mr. J. H. Northey, of the firm of Northey & Co., steam pump manufacturers, Toronto, is at present in Europe looking after the interests of one of the firm's recent inventions.

Manager J. J. Wright, of the Toronto Electric Light Co., is the owner of a handsome yacht, and has lately returned from a two weeks' cruise on the lakes. Mr. Wright's enthusiastic interest in electric development is almost equalled by his longing to live the life of a jolly tar aboard the steam yacht in question.

We little thought as we presented the readers of the NEWS a few weeks ago with a portrait and brief outline of the career of Mr. James E. Baird, President of the Canadian Association of Marine Engineers, that we should soon be called upon to chronicle his death, but such is now our painful duty. Mr. Baird passed away on August 13th at his home in Toronto, after a few days illness. The news of the sad event was received with the deepest regret by the circle of his acquaintances, and particularly by the members of the Marine Association, of which he was the chief executive officer. The members of the Canadian Association of Stationary Engineers joined with their brethren of the Marine Association in attending the funeral and in presenting beautiful floral tokens of loving remembrance to one who in life commanded their highest respect and esteem.

ROBIN & SADLER
MANUFACTURERS OF
Leather Belting
SPECIALTIES
DYNAMO BELTS
WATERPROOF BELTING
MONTREAL TORONTO
2518 & 2520 NOTRE DAME ST. 129 BAY ST.

SPARKS.

We understand that Messrs. Cone & Knight have commenced the manufacture of a new style dynamo at Fergus, Ont.

The electric light man has struck the town of Fleshertown, Ont., and as a result of his persuasive eloquence, a local paper states that the place will probably "emerge from its darkness in the near future."

The Canadian correspondent of the *Electrical World*, apparently from a desire to be thought enterprising, has in some of his recent communications made serious mis-statements regarding the business affairs of some of the Toronto electrical companies. These statements have naturally enough called forth indignant protests from the parties affected by them. Correspondents should not allow their zeal to lead them into presenting to the world statements which are contrary to the facts, and which are perhaps calculated to work injury to the parties whose names are connected with them.

St. John is now probably one of the most brilliantly lighted cities in the Dominion (owing in a large measure to the interest created in electrical work by the electrical exhibition recently held in that city), there being five of the finest central stations of electric light companies in the city, running the Edison, Thomson-Houston, Fort Wayne and Brush electric light systems. The competition between these companies brings the "light" within the reach of the citizens generally, and very many of the property holders have therefore indulged very lavishly in electric light. In addition to this the Corporation of the city is now running electric lights of their own in the north end, Brush plant, and Messrs. D. W. Clark & Son are running the Brush system at the west end, and the New Brunswick Electric Light Co. (Fort Wayne system) have completed their arrangements for lighting the east end, and are giving splendid satisfaction.

Electric Light Supplies

Covered Wire, Insulators, Cleats,

Soldering Salts, Tape, Cut-outs,
Switches, Sockets and Shades.

Alternating and Direct Current Dynamos,

Converters and Meters.
Repairs prompt and reasonable.

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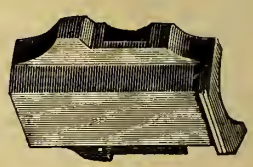


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Eureka Tempered Copper

JOURNAL BEARINGS





FOR USE IN

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COMMUTATOR BRUSHES,
ARMATURE BEARINGS,
GEAR PINIONS,
TROLLEY WHEELS,
STREET CAR BEARINGS,
TROLLEY WIRE,
ELECTRIC WIRE,
ENGINE BOXES, FRICTION CLUTCHES,
STEAM PUMPS AND VALVES, &c., &c.

Warranted to outwear any Brass, Bronze, or Anti-Friction Metal in the market, with

LESS OIL AND LESS LOSS OF POWER.



In a test of Eureka Tempered Copper at the University of Pennsylvania in Philadelphia, its strength was shown to be:

Tensile strength per square inch	41,230 lbs.
Breaking strength per square inch	41,130 lbs.
Total elongation	17 per cent.
Strength in compression	189,000 lbs.

The Committee on Science and Arts of the Franklin Institute, after subjecting the metal to the severest tests, reported as follows:

"We are of the opinion that the Eureka Tempered Copper Co. has made a decided step in advance in the preparation of copper for many uses, and we recommend the award to Almer Thomas and Luzerne Merket, of the John Scott Legacy Medal and Premium."

For copies of testimonials and all information, address the sole manufacturers,

EUREKA TEMPERED COPPER CO.

Western Sales Office:
American Ry. Equipment Co., CHICAGO, ILL.

Eastern Sales Office:
35 BROADWAY, NEW YORK.

H. WARD LEONARD & CO.

MR. H. WARD LEONARD, the general manager of the light and power department and also of the intelligence department of the Edison General Electric Company, resigned upon August 2 in order to start an independent electrical machine business under the above title. The new concern will be an incorporated company under the laws of the State of New Jersey. Mr. Leonard will take with him several well tried assistants who have been associated with him in the past, some of them as far back as 1885. Among those who will thus be connected with the company are Mr. A. St. C. Vance, Mr. E. H. Harrison, Mr. C. H. Bloomer and Mr. August Manning.

The company will operate specially in a field which is full of promise for the future, and is at present inadequately occupied, namely, the transmission of power by electricity, and the application of electric motors to the operation of special machinery, such as is not at present operated by electric motors, or whose operation is subject to improvement by careful attention to the requirements of the case.

Mr. Leonard's experience since 1883, when he became a member of Mr. Edison's first electrical engineering staff, has brought him into contact with every branch of electric light and power work. He has held positions from the lowest to the highest in the exploiting parts of the business, as well as in the constructing and in the operating of every kind of electric light and power plants, and it is not therefore altogether surprising that he should feel willing to resign his office with the Edison Company to take up a line of work which promises so well for one having such an exceptional experience as he has been fortunate enough to have.

H. Ward Leonard & Co. will have one important feature of their business which will be entirely unique, namely, an Electrical Intelligence Department. To any isolated plant the company offiers at a very moderate subscription price ($25 a year) the privilege of corresponding upon any electrical subject of practical interest, and thus an isolated plant will be able to secure expert information as to its own plant and the best methods of operating it, and about any new electrical apparatus, or methods and the principles underlying various devices, and the prices thereof. For central station companies, whose queries would go further into steam engineering and methods of distribution and also would cover business questions as to relations with consumers, systems of accounts, etc., the annual subscription charge for this electrical intelligence will be $50.

This scheme strikes us as an excellent one, and we have no doubt that any plant will get several times the value of the subscription price by placing before this company the matters upon which it desires information, data and statistics. As Mr. Leonard created and developed the Intelligence Department of the Edison General Electric Company, he has had the broadest possible experience in this line, since information of every character issued to those in the Edison Company has been issued by the Intelligence Department of that company. In case the expert jungment of the company be desired as to the comparative merit of various competing apparatus or methods, such expert judgment will be given by special arrangement, although the company prefers to merely supply full information under the subscription arrangement and allows the purchaser to form his own conclusions.

H. Ward Leonard & Co. will do no manufacturing, and will do no supply business, neither will they under any circumstances act as the selling agents of any concern, directly or indirectly. They will, however, act for the purchaser, either as consulting engineers, supervising engineers, inspectors or purchasing agents. When acting this way they will make the following charges, based upon the contract price:

For making preliminary plans, designs, distributions and estimates, 1 per cent.; making final plans and specifications, 1 per cent.; drawing and executing contract on the behalf of the purchaser, 1 per cent.; supervising an installation made by another contractor, 3 per cent.; inspecting and reporting on the work of another contractor, 1 per cent.; acting on the behalf of the purchaser in making the settlement with another contractor, 1 per cent.; acting as the agent of the purchaser, from the beginning to the final settlement of a contract, including the making of estimate plan, termination, specification, contract, supervising the installation, final inspection and report, and final settlement, 5 per cent.

It will be seen from the complete schedule given above that the purchaser will be able to obtain the services of this company for any portion of the work, and under terms which are so reasonable that there can be no question in the minds of those familiar with the subject that any purchaser contemplating the installation of an electric plant would not only save a great deal of his own time and be spared a great deal of annoyance, but would actually effect a very material saving in retaining the services of a concern such as this to represent the interest of the purchaser.

The various fan companies will also, no doubt, welcome the advent in the electrical field of an electrical engineering concern of this order, whose experience and ability is undoubted, and who are free from prejudice and have no affiliations of any kind with any of the various electrical concerns. Any parent electrical company can confidently refer a prospective purchaser to such a concern as this, with confidence that any opinions given by it to the purchaser will be based on the honest judgment of a firm thoroughly competent to judge any practical electrical question.

H. Ward Leonard & Co. will make a specialty of the transmission of power and the application of electric motors to such uses as necessitate the application of a wide experience in both mechanical and electrical engineering. Such applications of electric motors as met with in elevators, pumps, hoists, mine tramways, printing presses, etc., are those which this company feels itself especially qualified to undertake under guarantee of perfectly satisfactory results.

A by-law has been carried authorizing the expenditure of $75,000 upon the construction of an electric railway from Port Arthur to the boundary of Fort William.

The Street Railway Committee of the Toronto Junction council has recommended the acceptance of the offer of the city and suburban electric street railway, and to grant the company the right of way and franchise over the streets of the town.



ARE YOU COMING TO MONTREAL?

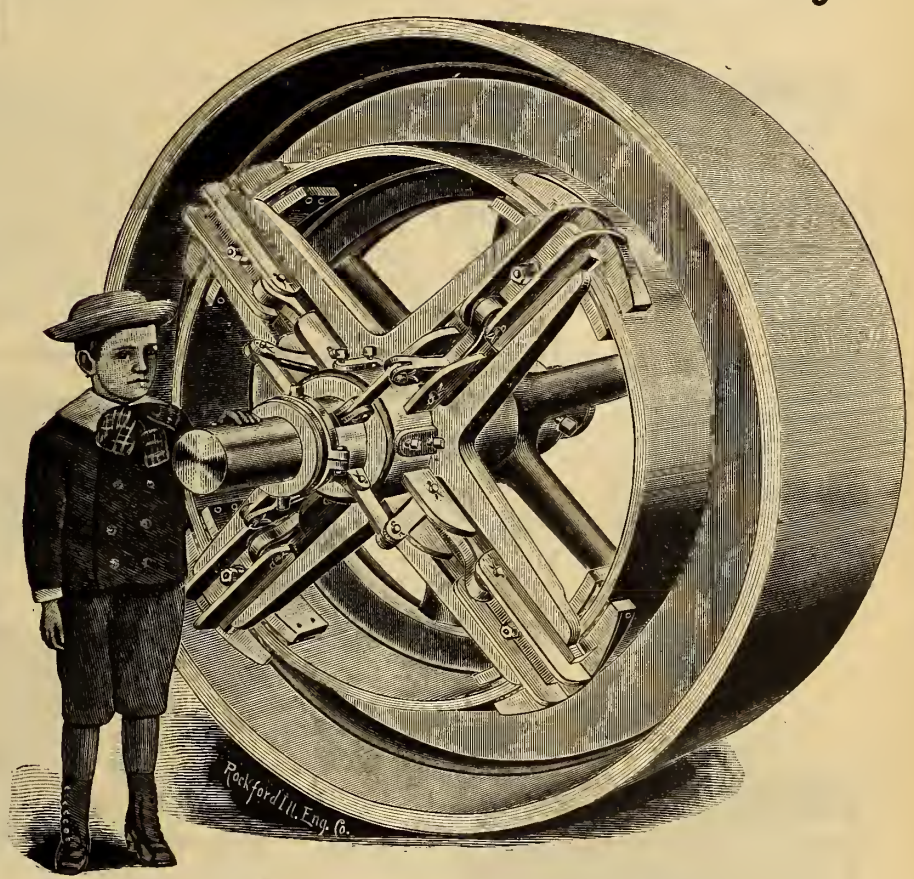
IF SO, PUT UP AT THE

TURKISH BATH HOTEL

On St. Monique Street, near the Windsor. 150 rooms. Quiet, comfort, luxury. No intoxicants. Terms moderate. All forms of water baths free to guests. Patronized by professional men, temperance men and the best class of travellers.

F. E. McKYES, - Manager.

Hill Patent Friction Pulleys



AND CUT OFF COUPLINGS

For Electric Light Stations and all purposes where intermittent power is required.

MILLER BROS. & TOMS,

(Successors to Miller Bros. & Mitchell)

Toronto Office: 74 York Street. MONTREAL, QUE.

ESTABLISHED 1869.

SPARKS.

The Montreal town clocks are regulated by electricity.

Gen. C. H. Barney, of New York, has been appointed general manager of the Montreal Electrical Exhibition, and is now in Montreal getting matters in shape.

The Bell Telephone Co. will place instruements at different parts of the exhibition hall for the accommodation of those who attend the Montreal convention. The Edison company has offered to light free of charge the tent which is to be placed on McGill University grounds for the Montreal conversazione. A number of long distance telephones will also be in operation between the Montreal electrical exhibition and some of the principal American cities.

We hope the American delegates to the Electrical Convention will receive such hospitable treatment at the hands of the citizens of Montreal, and find so much to interest and please them in the scenery of Quebec, that they will resolve to convene in Canada again at some future time. In the event of such a resolution being reached, may we not hope that Toronto, which has earned the name of the "Convention City," will be selected as the scene of the gathering.

Mr. Henry E. Haferkorn, Milwaukee, Wis., is the publisher of a "Handy List of Books on Mines and Mining," which should serve the purpose of a useful catalogue to persons interested in mining matters.

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Guaranteed Superior Quality and Economical.

SAMUEL ROGERS & CO.,

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MANUFACTURERS OF

Finest Engine, Cylinder and other Oils

STEAM USERS

Desiring the services of COMPETENT ENGINEERS of any class, can obtain sober, intelligent and reliable men, by applying to

CANADIAN ASSOCIATION STATIONARY ENGINEERS.

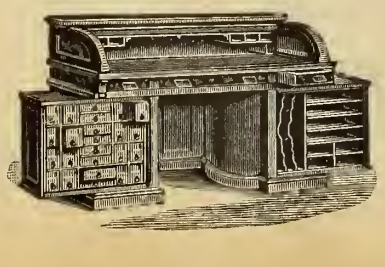
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JAS. ROBERTSON, Secretary Montreal Branch, 1420 Mignonne Street, Montreal.

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F. E. Dixon & Co.

MANUFACTURERS OF

LEATHER BELTING

70 KING STREET EAST, TORONTO.

HEADQUARTERS FOR

ELECTRIC LIGHT AND DYNAMO BELTING.

We have the following Leather Belts in use in the works of the Toronto Electric Light Co. :—

One 36 inch belt 98 feet long.
One 36 inch belt 100 feet long.
One 36 inch belt 123 feet long.
One 38 inch belt 100 feet long.
One 24 inch belt 100 feet long.
And over 1500 feet of 8 inch belting.

All of the above belts are DOUBLE THICKNESS. The 38 inch belt is the largest belt ever made in this Province.

We are prepared to furnish belts of any size, two or three ply, up to 48 inches wide. Every belt fully guaranteed.

SEND FOR DISCOUNTS.

Dixon's Belting Hand-Book mailed free on application.



ESPECIALLY FINE ACCOMMODATION

— FOR —

DELEGATES TO THE ELECTRICAL CONVENTION.

EVERYTHING NEW AND TABLE FIRST-CLASS.

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ELECTRICAL and MECHANICAL,

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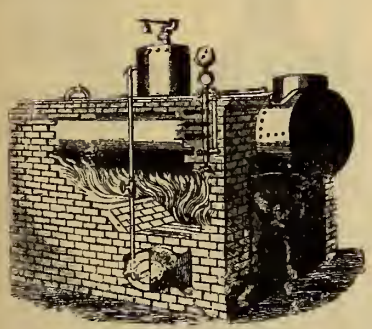
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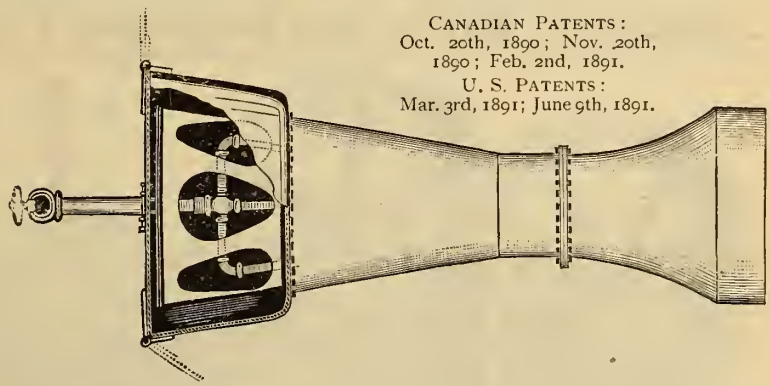
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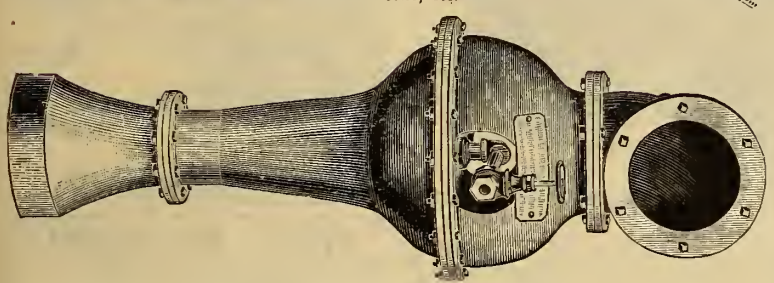
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Will burn successfully hard and soft coal screenings, tan bark, sawdust, coke screenings, cannel-coke, etc.

CANADIAN PATENTS:
Oct. 20th, 1890; Nov. 20th, 1890; Feb. 2nd, 1891.
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AIR INJECTOR.



COMBINED AIR INJECTOR AND EXHAUSTER.

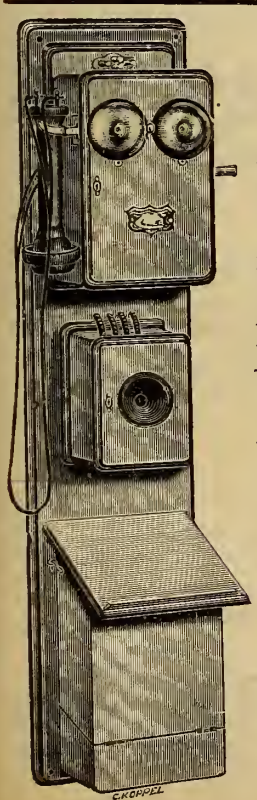
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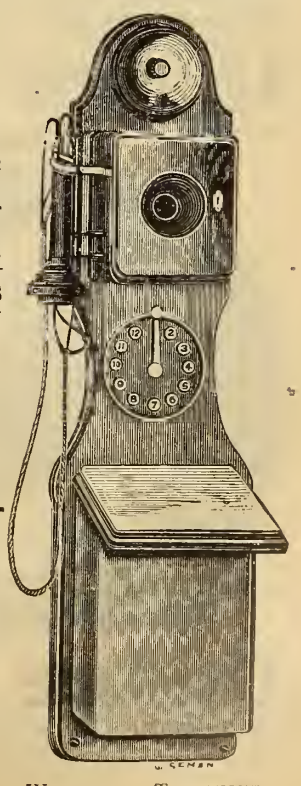
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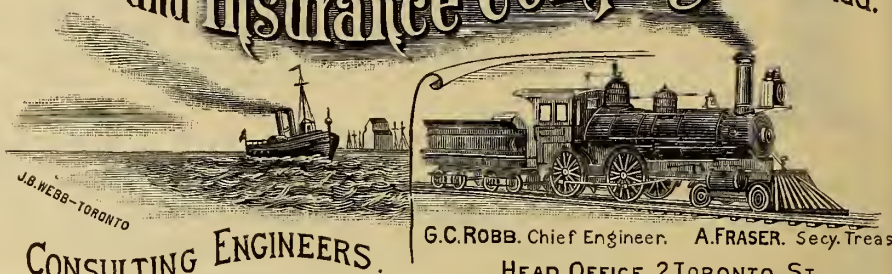
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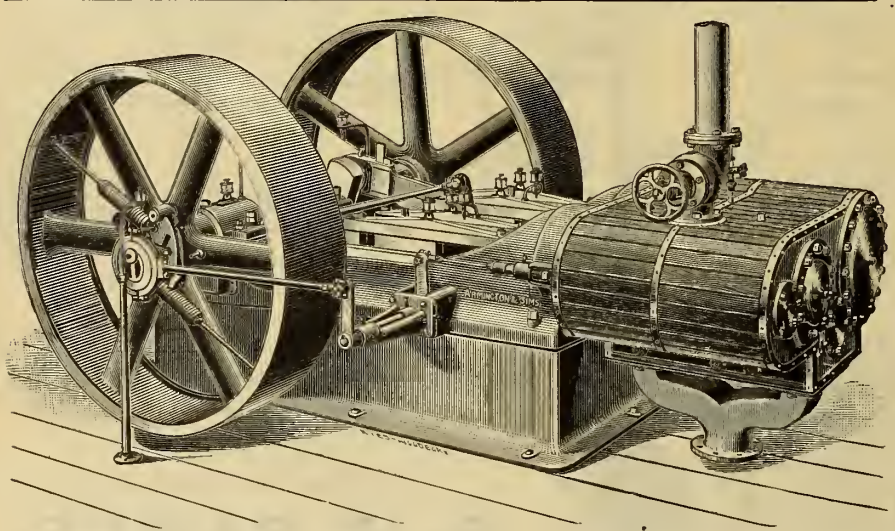
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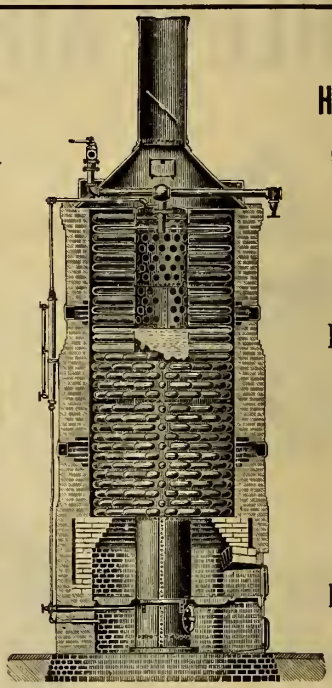


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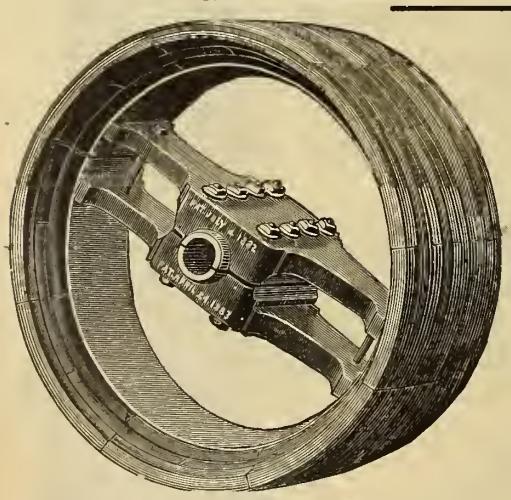
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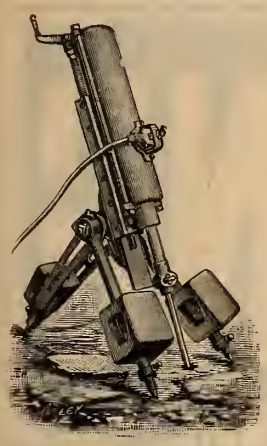
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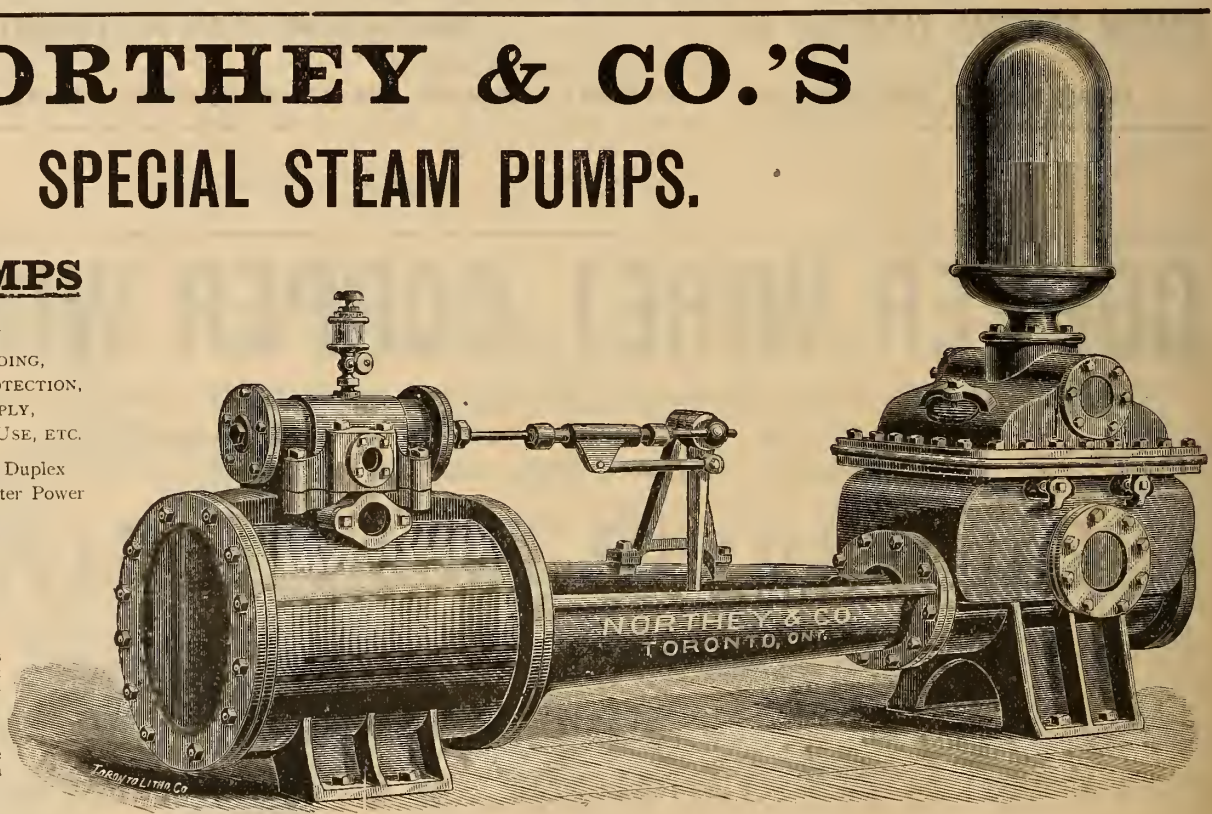
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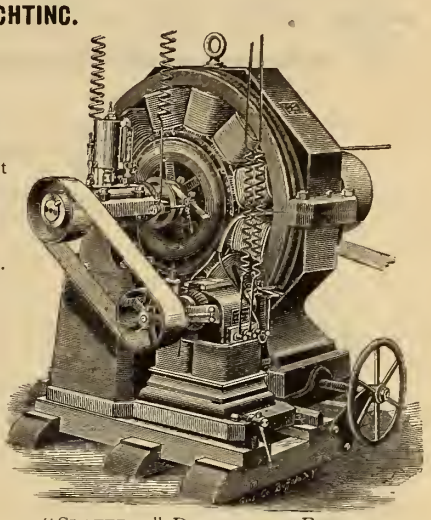
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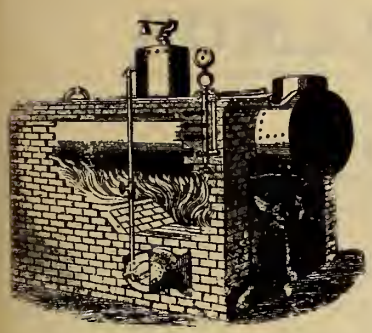
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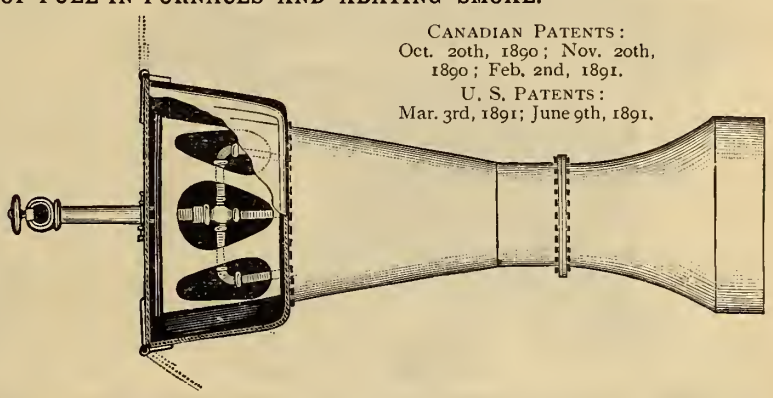
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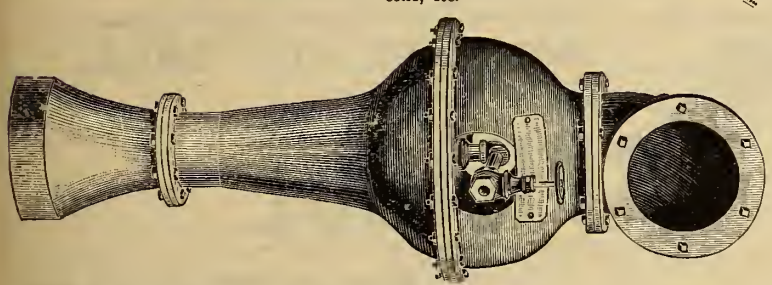
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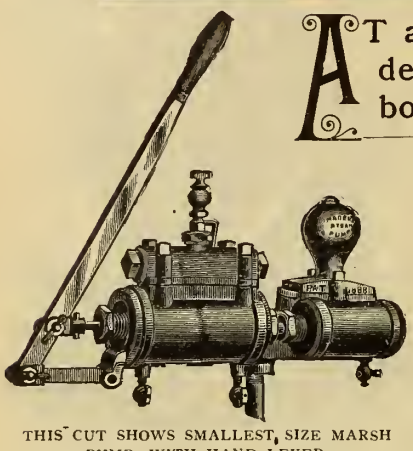
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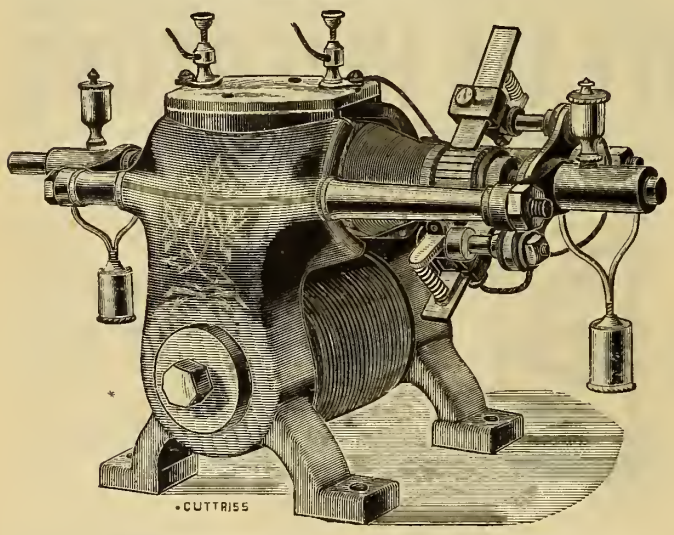
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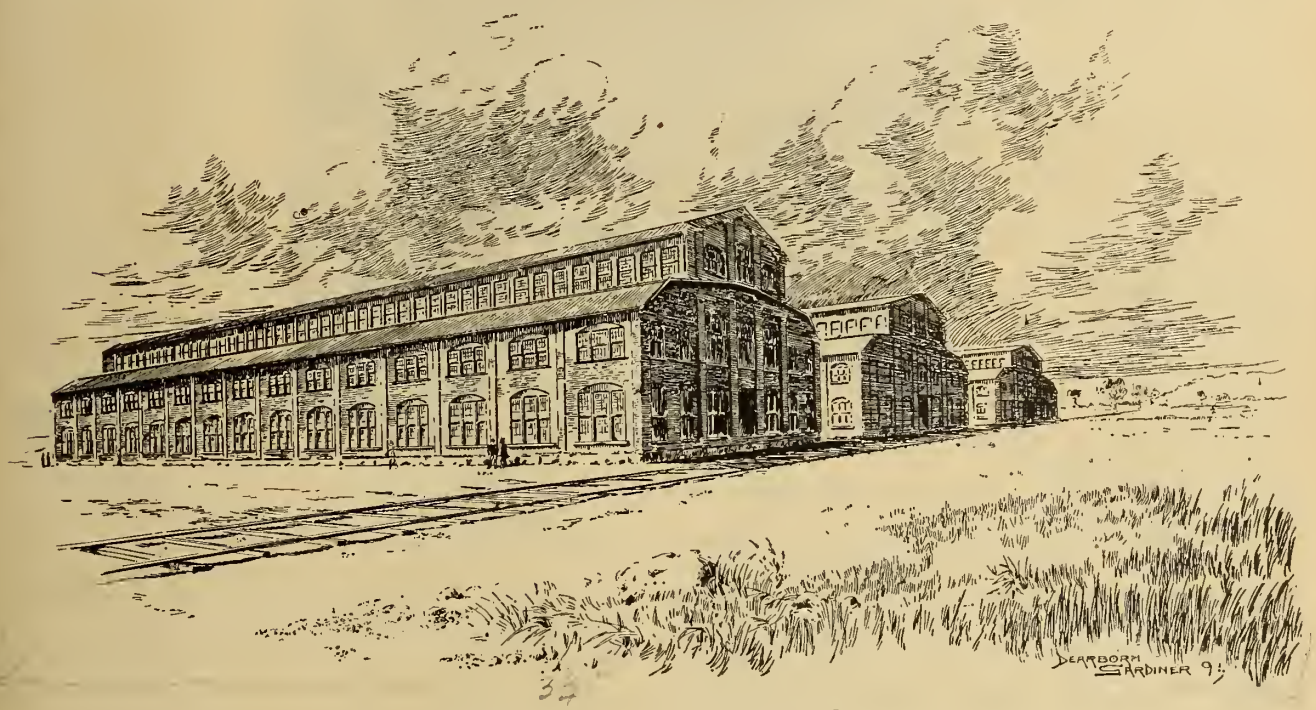
VOL. I. TORONTO AND MONTREAL, CANADA, OCTOBER, 1891. NO. 10.

THE EDISON WORKS, PETERBOROUGH, ONT.

THE accompanying illustrations and description of the Edison General Electric Company's new manufactory at Peterborough, Ont., are reproduced from an article in the *Electrical Engineer*, of New York, descriptive of the various branches of the Company's extensive business :

"It is a well-known fact that Edison lamps and other electrical apparatus are now being made and used all over the world by various corporations, as the result of the exploitation of the patents secured. But in the growing Dominion of Canada, whose relationships with us are already so numerous, the Edison General Electric Co. is carrying on the business itself. From a very small beginning, with only a dozen men in February, 1888, the Company has already come to employ hundreds of skilled mechanics, and is now concentrating its productive energies in a huge new factory at Peterborough, Ont. These Canadian Works are in many ways a replica of the vast shops at Schenectady. The property consists of about thirty acres of level ground, and the main building is without a doubt the finest machine shop in the provinces. It is 110 feet wide, 272 feet long, with a gallery of 25 feet on each side, and a central height of 60 feet. In it are employed about 400 hands engaged in the manufacture of dynamos ; motors for stationary power and electric railway purposes ; mining locomotives ; underground conductors; various small electrical instruments and appliances; electric cables and insulated wire. When the other buildings are finished, this will be used exclusively as a machine shop at once, and with that end in view it has already been equipped with a 10-ton travelling crane. Two other buildings, one 50 feet by 272, two stories high, and the other, 50 feet by 272, one storey, are in course of erection, and when finished will be occupied by the wire insulating and cable department. A power station is also in process of construction, with an ultimate engine and dynamo capacity of 1,000 h. p. In the distribution of power the same methods are followed at Peterborough as at Schenectady ; namely, all the power is transmitted electrically by means of underground conductors, and each shop is provided with an Edison motor to drive each main line of shafting. This mode of distributing power is at once a great convenience and a great economy, since the motors are entirely automatic and require no attention.

But this does not exhaust the plans. Two new buildings for the lamp factory, two for the carpenter and pattern shops, two for underground conductors, a second machine shop, iron foundry, brass foundry, office and store house are already laid out, and will soon constitute an imposing suburb, with the others, to the prosperous little city of Peterborough. The works have, moreover, direct railway connections with the Canadian Pacific and Grand Trunk railroads. These connections are for the exclusive use of the company and unite with four tracks running parallel between the two rows of buildings throughout the entire length of the property—1,800 feet. Besides these steam railway connections there are railroad tracks connecting all the buildings, over which loaded hand-cars may be run to any portion of the establishment. The Dominion may well be proud of this addition to its manufacturing industries.



THE EDISON WORKS AT PETERBOROUGH, ONT.

The recent catastrophe at Moenchenstein called attention to Riess's process for rapidly repairing ironwork by electric welding. The *Revue Industrielle* devotes some considerable space to showing how admirably this process works when applied to the repairing of various iron structures, rails, etc., that have become damaged by accident, and which, owing to the circumstances of such cases, required to be very rapidly repaired because of the traffic.

STEAM ADMISSION.

III.

In the last paper the action of steam on the engine piston was considered from the point of view that when the exhaust valve opens to allow the steam to escape, the pressure in the cylinder should not be *below* that into which it is to discharge, and should be only a little above that pressure. From this way of looking at the matter, the size of engine required for any given horse power can be determined when the speed of engine and pressure of steam are also known.

There is, however, another aspect of the part of the working of the steam engine which should not be overlooked. In the ordinary crank engine, the piston as it moves back and forth in the cylinder, has a constantly varying rate of speed, and at each end of the cylinder the motion stops. The piston, piston-rod, cross-head and part of the connecting rod, all partake in this rest, and change of direction and rate of speed. They are called the reciprocating parts, and their weight has much to do with the smooth working of the engine.

In order that an engine may work smoothly, the bearing surfaces must fit fairly, and be of such size that when the greatest pressure is on them, there may still be a film of oil between the metals. The crank pin is one of the most troublesome parts of the engine. It should be fair to the bearing in the connecting rod at every part of the revolution, and all who have had to do with engines know how difficult it is to get this, especially when an engine is being used with steam of high pressure, as only a very little bending or yielding of the frame is enough to make the crank pin out of truth in its bearing.

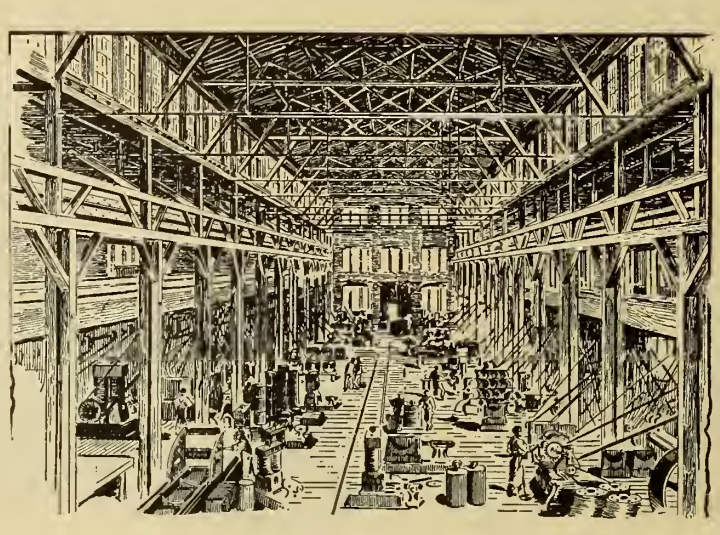
At the end of the stroke when steam is admitted and is at the highest pressure, the pressure passes straight through to the crank pin, and the pressure on the crank pin could be easily determined were the whole at rest, but, though the reciprocating parts are at rest, the crank pin is not, but is moving on in its course at its regular speed.

The pressure bears on the reciprocating parts and some of it is absorbed in producing motion in these parts, and the heavier they are the less the pressure in the crank pin during part of the stroke. The speed of the reciprocating parts gradually increases till at about half stroke, it is about the same as that of the crank pin. The power absorbed by the reciprocating parts during this time is equal to their weight lifted as many feet high as would be necessary in order to produce their velocity by falling. This can be calculated by the rules relating to the velocity of falling bodies.

So soon as the highest speed has been reached, it at once begins to slacken until it ceases at the end of the stroke. During this part of the stroke the reciprocating parts increase the pressure in the crank pin by the same amounts as they diminished it in the first part of the stroke, and the heavier they are, the more they increase this pressure.

By adjusting the weight of the parts for a known pressure and load, it is possible to have the engine working with an almost constant pressure on the crank pin.

It will be found a useful study to take an indicator diagram, and dividing it into about six parts, calculate the speed of the reciprocating parts at each point, and their effect on the pressure on the crank pin. If the reciprocating parts after half stroke are gradually losing speed, why keep up the steam pressure in the cylinder endeavoring to make them go faster, while the very construction of the engine compels them to go slow? Would it not be better to make the steam pressure so high and the reciprocating parts so heavy that the work could be done in the first half of the stroke and the exhaust opened almost immediately after half stroke?



Machine Shop, Edison Works, Peterborough, Ont.

DETERIORATION IN BOILERS.

"One very important cause of deterioration in boilers is due to their becoming too small to do the work without forcing, so that the pulsations of the engine cause a well marked succession of shocks on the boiler, which result in the weakening of the material."—*Journal of Commerce*, Aug. 28, 1890.

The above statement, if true, would be a most alarming one. Boilers are made of steel or iron plates, and a "succession of shocks results in the weakening of material!"

Railway bridges are also made of steel and iron plates, and every time a train crosses a bridge there is a "succession of shocks," and the material ought also to be weakened and in a short time the bridge will fall!

Many buildings are now erected with steel girders carrying the floors, and every time a man walks across the floor there is a "succession of shocks," and if this weakens the material, the man has only to keep on walking and down will come the building.

When a metal beam or bar is subjected to a load or to a shock, there is a tendency to change the form or to bend the beam. When the load is removed or the shock is over, the beam will resume its original position unless the strain produced by the load or shock has been in excess of what is sometimes termed the elastic limit of strength of the beam. If the strain be within the elastic limit, it may be repeated an infinite number of times and yet there will be no evidence of any weakening of the material, but if it be in excess of the elastic limit, it has only to be repeated a sufficient number of times to break the beam.

However, there is another feature of the action of the metal which must not be overlooked. It is that the limit of elasticity is not constant throughout the succession of shocks required to break the beam. After the load has been several times applied and removed, it is found that a greater weight is required to produce the same amount of bending; that is, the limit of elasticity has been increased. It is, however, a question whether or not the safety of the beam has been increased.

In the case of a steam boiler, it will be more intelligible if a definite example be considered. Let the boiler be sixty inches in diameter and made of steel plates 5-16 inch thick, double rivetted in longitudinal seams, and carrying a steam pressure of 120 lbs. per sq. inch, what is the strain upon the metal? Is it below or above the elastic limit of the metal?

The weakest part of the shell is the rivetted joint, but at that point the limit of strength is not the tensile strength but the shearing strength of the rivets, and of the metal between the rivet holes. The strain produced on the metal of a shell sixty inches diameter and 5-16 inch thick, 120 lbs. pressure, will be equal to about 11,520 pounds per sq. inch. The strength of boiler steel may be taken at 60,000 pounds, and the elastic limit at certainly not less than 25,000 pounds, so that to produce a strain equal to the elastic limit, the steam pressure would require to be about 260 pounds per square inch. The ordinary working pressure is not in excess of 120 pounds, and it must be a very unusual and remarkable arrangement of engine the pulsations of which could possibly produce a "succession of shocks" of sufficient force to raise that pressure to the amount necessary to affect the strength of the metal.

Engineers in charge of steam boilers and engines have troubles enough to contend with in keeping things right, without giving their nerves a "succession of shocks" over the idea that every stroke of the engine is weakening the plates of the boiler.

Mann Bros., electricians, Montreal, suffered a slight loss by fire on the 27th inst.

Mr. Westhead, engineer of the McClary Mfg. Co.'s works at London, was severly injured a few days ago, by being struck by the fly wheel. He is recovering.

THE MONTREAL CONVENTION.

THE formal opening of the fourteenth semi-annual Convention of the National Electric Light Association of the United States took place at the Windsor Hotel, Montreal, at 3 o'clock on Monday, the 7th of Sept. The attendance, which included a number of ladies, is said to have been the largest which ever assembled under similar auspices.

The presiding officers chair was occupied by Mr. Huntley, of Buffalo, President of the Association.

A cordial welcome was extended to the delegates on behalf of the city of Montreal by Prof. Bovey, Chairman of the Citizens' Executive Committee, Mayor McShane, Sir Donald A. Smith, Sir J. W. Dawson, principal of McGill University, Alderman Wm. Clendenning, ex-Mayor Beaugrand and Alderman Cunningham.

Sir Donald Smith, in his remarks, said he was "one of those who believe that a meeting of the people of different countries, and especially those who are neighbors, as we are, and have such constant and such great relations with each other in trade and in every respect, cannot but clear away many of those cobwebs and many of those ideas which we have had each of the other and which were entirely erroneous."

President Huntley, in his reply said : "For the first time in its history the National Electric Light Association meets on other than its native soil. Yet even in so doing it but adds new evidence to the feeling in the breast of every electrician, that his art is foremost among the influences tending to promote human intercourse and break down the walls of separation," and he added, "If the earnest and practical quality of our dealings with the great questions of electricity shall in any wise stimulate electrical work in Canada, and lead to the electrical utilization of its great water powers and coal beds, in light, locomotion power and heating, we trust it will be accepted as at least some slight acknowledgement of the manner in which we have been so generously greeted."

General Knapp, U. S. consul, Judge Armstrong and Mr. Erastus Wiman, also responded. The latter, among other things, said : "I doubt if any system in the world is more perfect than the system of telephones in Montreal and Toronto. I doubt if any city in the United States has such a development of that marvelous instrument as those two cities have. As to the telegraph service, somewhat connected with it as I am, I believe I may say that there is a larger mileage of wire, a greater number of offices and a greater number of messages transmitted in proportion to the population in Canada than in any other country in the world taking distance into consideration ; so that in telephony and telegraphy electricity has found, on this continent, in this Canada of ours, its greatest development. I would like to say to Canadians, though, that in certain things in the United States a greater progress has been made than here, and that is one idea I had in asking to speak to you to-day, namely, that I should draw your attention to the marvelous growth in the United States of the use of electricity in the street railway. It seems to me that no one thing has grown with such rapidity as the value of real estate wherever there has been an electric railway introduced. * * * I want to impress on my friends in Canada the advantage that the electric system has in the transmission of power. I was in Boston on Friday and stood in one station which has a capacity of 20,000 horse power. It seems to me I do my duty as a former citizen of this place and still somewhat interested in it, in drawing the attention of the residents here to the fact that they possess the potentials of power almost beyond any city in the world. In the great rapids, above them and below them, are forces which, if applied by electricity, would be of the greatest advantage. I know of no city that has such enormous facilities for the creation of electricity as this city has. I know of no place in which power can be transmitted so perfectly and completely as in this city, so that a delicate wire running over a house might work a fan in a sick room, and in the next block might lift a trip hammer ; so that a sewing machine, or half a dozen of them, or fifty of them, or a factory, could be run from the St. Lawrence and Ottawa by the transmission of this power. An optician might grind the most delicate piece of glass in a small lathe before him, and even the running of a sewing machine and the rocking of a cradle might all be done by electricity. * * * So far as the city itself is concerned, I have the belief that your presence here will stimulate and draw attention to this question of not only having every street equipped with electric railroads, but making every ripple on the rapids contribute to the wealth of the city. I cannot but think that the great progress that electricity has made and your presence here will bring popular thought and popular opinion to bear on this question of the use of this tremendous force that lies now idle, so far as its transmission is concerned. If that should occur, it would all be attributable to the fact that the National Electric Light Association held its meeting in the city of Montreal. Montreal has facilities for manufacturing greater than any other city in the world. It has got raw material at its hands ; it has got the cheapest and the best labor; it needs only the touch of electricity to make it the greatest city and this the greatest country under the sun."

President Huntley delivered the following address :

My predecessors in this chair have seen the association advance in strength and worth, outliving trials and vicissitudes, to emerge on a wider, larger field of usefulness and opportunity. I do not believe that there is another industry in the world which has passed through such quick stages of evolution as ours, and become so soon established in popular favor and general prosperity. But we must not assume that because electric lighting has set its feet upon the rock and laid its deep foundations, nothing more remains to be done save pursue the policy and practice of the past. On the contrary, I deem it necessary to say here that my own responsibilities as a central station manager compel me, as never before, to be watchful of the tendency of conditions and inventions in the art, so that I may in any degree profit from my own hard won experience. If, as central station men, we are to secure adequate return on the investment committed to our care, it becomes us in every way to study closely all the ideas that will give higher efficiency of plant and higher economy in operation. There was a time when some of us expected to grow rich out of abnormal prices. To-day there is not one of us who does not know that his hopes of dividends lie wholly in the skill with which the best business ability and the soundest engineering are applied to the work in hand.

I take it that it is now pretty well recognized among intelligent station managers that the day has passed when they can limit themselves to one class of services or apparatus to the exclusion of all others. To obtain the fullest measure of sucess and the largest return from the capital invested, they must be ready to supply any demand made upon them ; as a result, the successful station, even to-day is gradually assuming a composite character. This compositeness is manifesting itself first in the variety of apparatus, as a result of the selection of the machines best adapted to a given class of work, and independent of any particular system. One cannot help seeing in this change from early practice a step toward increasing efficiency of station operation, as well as a good reactive effect upon the manufacturers of apparatus, who are thus all placed on a common basis of competition. But besides a compositeness in detail, signs are not wanting that no one method of distribution from a central station can, in the large majority of cases, be adequate to the demands that are made upon us, and that to meet them in a manner to insure a profitable business requires a flexibility and variety in methods of distribution, the full extent of which is to-day hardly recognized. To reach the full limit of usefulness the central station should avail itself of methods which, I believe, will finally resolve themselves into what may be called the "zone system" of distribution.

The idea embodied in this zone system can best be explained, perhaps, by taking a concrete, practical example, and for this purpose the present occasion makes the city of Montreal an interesting one. Setting aside for the moment the possibility and even the probability of the transmission of electrical energy to the city from the power obtained at the Lachine rapids, we will assume a station erected at the water front of the harbor. It will, I believe, be granted that up to within a distance of one-third mile radius, the three-wire low tension direct current system of distribution answers fully every requirement of simplicity and economy, and hence if, with the station as a centre, we draw a circle having a radius of one-third mile, we shall have a "zone" supplied in the most economical manner for every class of light and power apparatus now familiar to us.

Coming to the districts beyond the first zone, we are necessarily obliged to have recourse to higher potentials for the feeders, and the selection of the proper potential is a matter of simple calculation. We may, for the sake of this argument, call it 500 volts. Continuing on in this way, in steps of 500 volts, successive zones, half a mile across, might extend, in the aggregate, to several miles without reaching the limit of potentials which have been found to be perfectly feasible in practice.

In the example no reference has been made to the nature of the current employed or to the method of local distribution. Evidently we may readily resort to the alternating system, employing converters to reduce or raise the potential. Perhaps some of our new school of electrical engineers will show us how to use the same circuits for both alternating and direct currents.

But, whatever system is employed, I deem it proper to record here my conviction that the most economical way to distribute the current to the consumers at the point of delivery is by low pressure conductors, in contradistinction to the plan now generally in vogue of giving each customer a converter of his own or, in the direct system, a separate motor dynamo. I need not here enlarge upon the train of reasoning which has led me to this conclusion, but I may remark that I am strengthened therein by my own experience in Buffalo, where we are now introducing gradually 200 light converters and replacing the smaller ones heretofore employed. Nor do we propose to stop there, but expect to install converters of still higher capacity, distributing the current to a number of customers by low pressure mains centering at the large converters. As addressing myself to practical men, I need not refer to the fact that it costs practically no more labor, &c., to put up a 200 light converter than it does a 10 light, while the initial cost per light is less in the case of the larger converter. In these conclusions I am only recommending for large American areas what, I believe, is recognized abroad by Ferranti and others, whose work, like our own, will eventually lead to the establishment of large converter sub-stations from which low tension wires will supply the surrounding districts.

The allusion made to the motor-dynamo system for converting the direct current from high to low potential may to some appear nothing more than the citing of a possible method in view of the existence of the alternating system, well tried and ready at hand. But without wishing in the least to detract from the merits of this system, which has probably done more to popularize electricity than any other, I cannot, as a practical man, conceal from myself the fact that, taking everything into consideration, the low tension direct current system of distribution is the most flexible within its area, and serves the greatest variety of purposes. I do not think that any one can successfully contradict the assertion that to say no other system can, with equal efficiency, take care of arc and incandescent lamps, motors, large and small, storage batteries, electric heaters, &c.

In making this statement I desire to be understood as referring to the present condition of the art, the only condition which, as practical men, we ought to consider in matters of this kind ; but I hope the time will soon come when the same can be said of the alternating system. There are still other methods which suggest themselves, by which the "zone" system could be effectively carried out, but those indicated are sufficient to demonstrate the idea I have endeavored to convey.

After the intelligent station manager has decided upon the nature of his apparatus and the initial capacity of his station, his most important consideration is the allowance to be made for future growth. Look back, some of you, and recall the mistakes made, but which were brought about by the enormously rapid growth of the industry. I need not go out of my own experience for such an example. Less than two and a half years ago we erected in Buffalo a new station considered far too large for even the most extended future growth. Some of my colleagues shook their heads. Yet

even to-day it is being worked to its fullest capacity, and provision will soon have to be made for more facilities.

What, then, may be asked, shall we determine upon as the unit time limit of growth for which provision should be made? Shall we build our stations sufficiently large to take care of the demands of five, or ten, or twenty years hence? This is a most serious question, and one to my mind as important as the selection of the proper station apparatus itself. I note the erection of several stations abroad, and some here, designed to supply the demands some 15 or 20 years hence. Without wishing in any way to detract from the laudable enterprise and faith exhibited by the promoters of these stations, a calm survey of the past, present and probably future condition of the art leads me to believe that the setting of so long a time limit as 15 or 20 years is inadvisable. I need not remind you in detail of the changes in methods and apparatus which have been effected during the last five years, by which the efficiency and output of our stations have been increased. And if to this we add the fact that already new methods, such as those pointed out by Mr. Tesla, may at any time increase the present lamp capacity of our stations five and tenfold, I think we may be justified in placing five years as the limit of time, to make provision beyond which may involve expenditures, the benefit of which may not be realized.

These are matters we are endeavoring to settle for ourselves. It is to our interest to settle them. So, too, with the underground question ; but there we have gratuitous advice, assistance and abuse to such an extent that less progress is made than in any other part of the work. We all want to put our wires underground where the number is so great as to make them unsightly or unwieldly, and not a few of us have been parties to experiments now written off to profit and loss. As soon as the time arrives when every house has its wiring as a matter of course, just as now it has piping for water and gas, it will be a comparatively easy matter to lay down comprehensive underground systems. But at the present time the customers for current are scattered and not continuous. The man with enterprise enough to take electric light and power soon moves into a larger store. His successor does not want the service, but gropes along with kerosene or spoils his goods with gas. Cutting out disused underground services is an added risk and expense, and ten lights could be installed on overhead circuits for ten dollars, where with underground the cost would be fifty. It follows that in any city—Buffalo, for example—we shall not make one underground connection, where with overhead wires we shall have made twenty. Now, are the public or are we the greater losers? The public, I think. It is as unreasonable in most instances to demand underground wires as it is to expect every railroad to make every crossing above or below grade. But for our overhead wires, America would not be to-day the great land that it is of electrical triumphs ; and, while I hail with delight every advance in the solution of the underground problem, I hope long to gladden my eyes with the sight of a pole well set and a wire well strung.

Another stirring question of the hour is that of municipal ownership. Now, it has been taken for granted that electric light men are against this plan, tooth and nail. How absurd that notion is ! Because we represent the latest development of invention and industry, we certainly do not forfeit our pride as citizens, nor lose our interest in the advance of social science. It would, in fact, be difficult to find a more progressive, well known body of men in America to-day than they who have put their money and energies into electric lighting. They are neither crusty nor cranky. But when any movement has been started for the betterment of the communities in which they live, some of them have been at its head. Now, is it strange that such men should object to the confiscation of the properties they have built up and that are beginning to pay? Is it strange that they should ask for these new theories in social economy to be tried on something else first? Many of them have grave doubts as to the accuracy of the figures that are supposed to prove that municipal plants pay. Others of us have great objection to any taxation, the proceeds of which are to set the municipality up in a commercial business ; others again believe that the best results are reached in an industry when it is freest from political influences and is left to the uplifting and perfecting impulses of individual enterprise.

I believe that the most conclusive answer we can make to the sophisticated arguments of an ill disguised socialism, presenting itself in this municipal ownership scheme, is to give the very best service possible at the lowest rates compatible with fair profit. Some of the prices we now obtain are so low as to exclude any profit at all, especially when repairs and reconstruction are considered. But here again we may help ourselves out by native wit. Every company in the ranks of this association ought to ascertain for itself at regular intervals just how it stands as an industry. A good deal of apparatus in use is decidedly inefficient. Overhaul it. If necessary, throw it out and put in better. Above all, adopt a good system of book-keeping. Electric light securities are to-day far from enjoying the esteem in financial circles that they deserve. This is due in a measure to speculative investment and to over capitalization in the past. But it is also attributable very often to the poor system of accounts employed, and I am glad to see the subject thus receiving attention. If we know what our current costs, we know what we can sell it for, and unless that information is obtainable from our office books, engineering will go for naught and capital required for new work will stand aloof.

In conclusion, I would urge that the association determine upon meeting only once a year. Even if it were not impossible to recover in six months from such overwhelming hospitality as we are now the recipients of, I believe that the time has gone by when half-yearly meetings were necessary. Once in twelve months is often enough for us to come together for the comparison of our experiences and the report of further refinements in the detail of the industry. The mere fact that frequent reunions are no longer necessary is in itself a hopeful sign, for it tells of stable and settled conditions and of activities that now require our presence at home pretty much the year around.

Gentlemen, I thank you for your attention, and I trust that your deliberations in the coming week will be characterized by the same earnestness which has marked them in the past.

Invitations were received and accepted to visit the museum of McGill University, the Montreal Art Gallery, the works of the Quebec & Levis Electric Light Co., and take a trip down the Lachine Rapids. The Convention reassembled at 10 a.m. on Tuesday, and received a report from a Committee on the revision of the constitution, recommending that no changes be made in it.

A discussion followed on a motion by Mr. Weeks that the Committee on relations between parent and sub-companies be instructed to formulate a definite plan of procedure for the protection of central station companies, and to prepare the necessary articles of agreement, and report the same to the Association in executive session at its next Convention.

The Committee on data presented a partial report and asked permission to continue its labours, which was granted. The concluding paragraph of the partial report referred to, states : "One electric company has found it advantageous to make a thorough test of all the leading steam engines and boilers offered for this purpose. Our organization offers great advantages over individual or corporate enterprises in this direction. We have almost every type of equipment in use, and it only remains to record the performances to make the advantage of membership in this organization as apparent from a purely financial basis as it now is on the basis of education and social enjoyment."

Mr. Hornsby, representing the World's Columbian Exposition, as Secretary of the Department of Electricity, reported what had been done and is proposed to be done to render that Department interesting and instructive.

Mr. Francisco read a report on underground conduits.

The business sessions on Wednesday and Thursday were devoted to the reading and discussion of papers.

The Secretary's report, presented on Friday, showed an increase in membership from 172 to 220. The report suggested that the Committee on data be increased in its membership and that the collection and distribution among members of important facts, figures and details relating to the furnishing of light, heat and power be carried out systematically and persistently throughout the year.

Dr. Mason offered the following resolutions, which were unanimously adopted by a rising vote :

The National Electric Light Association, assembled in Montreal, at the close of its session desires to put upon record its appreciation of the distinguished honor shown it by the Dominion of Canada in the presence of His Excellency, Lord Stanley of Preston, Governor-General of the Dominion ;

Of the large-hearted hospitality of the city of Montreal, evidenced by many graceful acts, official and individual ;

Of the tireless industry of the Citizens Executive Committee, whose efforts have carried to completion the most successful meeting in the history of this body ;

Of the grand work done by the Committee on Exhibits, issuing in an exhibition of great educational value calculated to develop a larger appreciation of the flexibility of electricity, and its wide adaption to human needs ;

Of the gracious liberality of McGill College, which has lent the great dignity of its name and the personal influence and labor of its officials to the success of our meetings ;

To the press of the city, whose extensive and fair reports of our meetings have extended our influence ;

To the railway companies for their liberal reduction in fares, and to the Windsor Hotel management, where as guests we have found a home.

Resolved. That the above minutes be placed on the records of the Association, and a certified copy thereof be sent to the various bodies mentioned.

The following resolution was also adopted :

Resolved, That a vote of thanks be tendered J. I. Gulick for the efficient and successful management of the exhibition now being held under the auspices of this Association, the largest ever held on this continent,

And that the Secretary be directed to have this resolution engrossed and presented to Mr. Gulick.

On motion of Mr. Seely, seconded by Dr. Mason, a vote of thanks was extended to Luther Stieringer and Allan R. Foote.

Frederic Nicholls, M. D. Law and A. M. Young were elected members of the executive committee of the third class.

Dr. Mason gave notice of the following amendment to the constitution—that in the first article the word "International" be substituted for the word National, so that the title of the Association would be the International Electric Light Association.

Buffalo was selected as the place for holding the February meeting of the Association.

The Convention then adjourned.

NOTES.

Messrs. Robt. Mitchell & Co., of Montreal, made an interesting display of artistic fixtures.

The Royal Electric Co. supplied power for a number of the exhibitors, but did not make a display of their goods.

The *menu* of the closing banquet was very much below the standard, and the same can be said of some of the waiters.

Messrs. Robin & Sadler's exhibit of leather belts manufactured for the Royal Electric Co., attracted considerable attention.

A miniature model of Dansereau's electric wire subway, recently illustrated in the ELECTRICAL NEWS, was exhibited by the inventor.

Mr. J. Fitzgerald, of Montreal, displayed combination gas and electric fixtures to which were attached the universal bracket joint, of which he is the inventor.

Prof. Bovey's little daughter pressed the magic button by which the electric current was switched on and the machinery and lamps in the exhibition set in operation.

The Toronto Construction and Electrical Supply Co. had a large and interesting exhibit, in charge of Mr. Nicholls, the manager, and his assistants Messrs. G. C. Stanuard and A. J. Christie.

T. W. Ness, of Montreal, displayed in attractive form a variety of electrical novelties and supplies, including telephones for attaching to office desks, and a sewing machine operated by an electric motor.

The most prominent subject of remark was the royal hospitality of the citizens of Montreal. Never in the history of the Association have the delegates to a convention been so elegantly entertained.—*Electrical Review.*

To General C. H. Barney, Manager of the exhibition, and

Mr. J. I. Gulick, Chairman of the Exhibit Committee, is due the credit of reducing the amount of "friction" in connection with the running of the exhibition to a minimum. There were few, if any, "hot boxes."

The Dominion Wire Mfg. Co., of Montreal, had an attractive exhibit to the left of the main entrance, consisting of galvanized telegraph and telephone wire, hard and soft drawn copper wires and stay wire, brass wire, iron and steel wire in bright, annealed, galvanized and tinned.

The Ball Electric Light Co. was a little late in arriving, but their exhibit under the skilful management of Mr. W. A. Johnston and his assistants was soon put in order. The exhibit embraced 4-ampere double armature arc light machines, Bernstein incandescent lamps, Wenstrom generators and motors, and a general line of supplies.

The word "Phillips," composed of 16 candle power incandescent lamps, surmounted the exhibit of wires and cables by the Eugene Phillips Electrical Works, of Montreal. Mr. John Carroll, manager of the Company, was one of the most active personages in connection with the exhibition and Convention.

The Canadian District of the Edison General Electric Co. occupied by far the greatest amount of space allotted to any exhibitor. It was conspicuously located in the centre of the building. Mr. Barr, district manager, assisted by Mr. W. W. Bremer, district engineer, and Mr. W. R. Rosenstengle, represented the Company's interests.

The Fort Wayne Electric Co. was represented by its Canadian agent, Mr. W. J. Morrison. The Company had a very handsome exhibit, consisting of a 750 light, compound wound alternator and a 15 light arc machine, operated by two Armington & Sims engines located in the Windsor Hotel. During the exhibition, Mr. Morrison booked an order for a 60 light plant.

The *Electrical Age* with becoming modesty asserts that "a greater number of those present took more interest in the daily edition of the *Electrical Age* than in any other one thing that brought them to Montreal." With not less becoming modesty it may be said that the Convention Number of the CANADIAN ELECTRICAL NEWS, of which several hundred copies were judiciously distributed at the Convention, met with a very favorable reception.

About fifty of the delegates paid a visit to the city of Quebec on Saturday, under the pilotage of Mr. A. J. Corriveau and Mr. Mohr, of the Quebec Electric Light Co. A very pleasant time was spent in viewing the many points of interest, including the wonuerful falls of Montmorency, and the lighting station which receives its power from the falls. On behalf of his friends in the National Association, Messrs. W. J. Morrison, A. F. Mason and W. J. Hammer presented Mr. Corriveau with a gold-headed cane, accompanied by a letter expressive of appreciation of his efforts on behalf of the pleasure of the visitors.

HINTS TO ENGINEERS.

By "EXPERIENCE."

THERE are engineers who are engineers, and engineers who are not. Suppose, for instance, we take a walk around town a little to see some of the steam plants. We walk into an engine room, the floor of which is covered with oil and grease, with waste packing, wrenches, etc., lying all around the place.

Next we take stock of the engine, that is, what we can see of her, for steam is leaking out of every joint, and she is in such a filthy condition, that one cannot discern the (that once was) bright part of the motions from the frame. Along comes the engineer, and he will be in keeping with his surroundings, and will very likely launch out in something after this style. "Pretty dirty hole this, ain't it? Oh, well, it suits the boss, and you can bet your life it will suit me. If he don't care, I don't see why I should." And so this engineer goes on week in and week out; all he looks forward to is shutting-down time and pay night, and in too many cases, a plentiful supply of bad whiskey.

Now for the better side of things. We will suppose that for some reason or other the aforesaid engineer leaves this job and another man comes on to take charge. Now this man, being a go-ahead kind of fellow, takes stock of the place, and sees what a filthy state things are in, and makes up his mind to go to work and clean up. He goes to his employer and asks for an order on the supply man for some waste. Instead of receiving the order he gets something after this style: "What do you want waste for? The engineer who preceded you did not want any, and I don't see why you should."

Now just at this time is where this man scores a point. Instead of sulking around, and saying, "Oh, well, let her rip," he goes home and asks his wife for some old rags (some men have bought waste themselves; the writer himself has, and to-day does not think he lost a cent by so doing), and commences to clean up his machinery, boiler fronts, and the windows around the engine room, through which little light has penetrated for many a day, being excluded by a thick coat of dust and dirt on both sides.

After he has got so far, he turns his attention to the engine room floor, and scrapes up the dirt and grease and gives it a thorough scrubbing with water and soda or lye.

By this time, things are beginning to look somewhat improved. Bye and bye the boss comes along, and very often he will take in the situation at a glance and think to himself—"So this is the kind of man he is. Well, now, that is an improvement, and I guess we will have to give him some encouragement!"

It is possible he may say something after this fashion: "Oh, by the way, engineer, you were speaking about getting some waste the other day. If you will call at the office, I will leave an order there for you to get some."

Of course I am aware that there are some steam users who do not care how their plants are run—whether they are kept clean or dirty—and this kind of employer never gives a thought as to whether his boiler is evaporating a fair amount of water in proportion to the quantity of fuel consumed. Such trifling affairs as these never bother him, because he is satisfied if he can keep his machinery running all day, and can manage to get a man to run his steam plant at a wage less than a common laborer. He has not common sense enough to see a goodly part of what should be his profits are going off up the smokestack, and through leaks, pistons and valves in the engine. But if we take particular notice, we shall, as a rule nowadays, find an employer of above stamp, and an engineer like the first mentioned in this article, in the same establishment, and it is right that it should be so. Thank goodness, this kind of employer and engineer are getting more scarce every year.

The coming successful engineer is the careful, thinking, studious man, who takes a pride in his engine and boiler room, and who makes the best use of his spare time in studying up electricity, for this is a subject that the engineer will have to tackle sooner or later. Even now, the dynamo has found its way into many engine rooms in our factories, and who but the engineer should be called upon to care for it.

Do not get disheartened because your employer does not appreciate your efforts to keep your plant clean and in good order, but rather strive all the more, because, if he does not appreciate your labor some one else will, and your plant will be talked about around town, and bye and bye some firm will be putting in a large and expensive plant, and a good many engineers will be after the situation. The first thing you know, you will be appointed, and all the other fellows will wonder how they got left. The fact was the firm were putting in an expensive plant, and they wanted a man to take charge of it who would take as much pride in it as if it was his own property. They had seen and heard from others how clean and nice you kept your plant, and what an interest you took in your work at Messrs. So and So's, and they decided to engage you and were willing to pay you good wages into the bargain.

Now who will contradict me when I say that in such an instance a man is well repaid for the extra interest he has taken in his work. Such instances are occurring all the time. The go-ahead engineer is at the top of the ladder every time, and will remain there, while the dirty, careless and intemperate engineer will go down from the fine, automatic cut-off to the small, hoisting and portable engine, and sometimes to the pick and shovel. On the other hand, the young engineer who starts on the small hoisting engine may by perseverance, good sense and "sand," obtain charge of the large plant and secure the largest salary.

The motto for every engineer should be "take an interest in your plant, be sober, steady and industrious; post yourself on all the latest improvements in your business, and your day will surely come; nothing can hinder it." The main thing is to be ready to take your chance when the time comes.

The Electric and Mining Co. has been organized at Ottawa, and is seeking incorporation from Parliament.

The Digby Electric Co. has recently been organized at Digby, Nova Scotia, with a capital stock of $7,000. Mr. H. A. P. Smith is superintendent and electrician. The capacity of the station is 600 incandescents. In use, 300 commercial incandescents; 20 public street incandescents. The company has two miles of street circuits. The plant will be in operation in a few days.

NOTES ON THE DESIGN OF MULTIPOLAR DYNAMOS.

(Continued from August Number.)

HAVING discussed the design of multipolar machines as influenced by both theory and practice, it remains to conclude this communication by calling attention to some of the ordinary forms of multipolar fields. The double wrought iron horseshoe (Fig. 4) is not very frequently used, being rather costly; but a similar machine, with magnets of cast iron, was lately made by my firm for the National Line S.S. America. The armature core in this case was formed by winding square annealed iron wires on a gun-metal flanged cylinder. The winding was of the Gramme

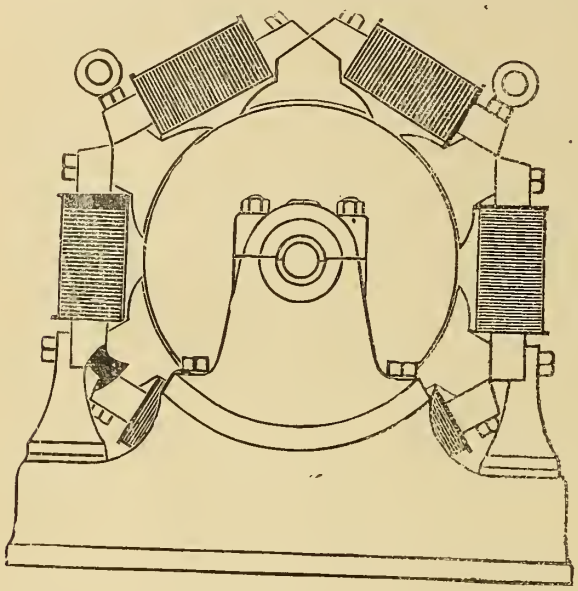


FIG. 7

type, and the machine was coupled direct to an inverted engine. This design, introduced by Gramme in 1869, generally gives place to the arrangement shown in Fig. 5, a form designed by the same inventor in 1885, and since adopted for cylinder-wound armatures by many makers, including Mr. Jasper, in Belgium, Mr. Brown, of the Œrlikon Works, in Switzerland, and Messrs. Patterson and Cooper, in England. Lately Mr. Knapp has used the same form for six and eight-pole machines with drum armatures. The magnets and octagonal yoke in Fig. 5 are of cast iron in two pieces, the lower limbs, the bottom half of the yoke ring and bed plate being one casting, and the top limbs and upper part of the yoke being another. Fig. 6 represents a similar field in which the magnet cores are of wrought iron, fitted with cast iron pole pieces, as used by Mr. Knapp in the

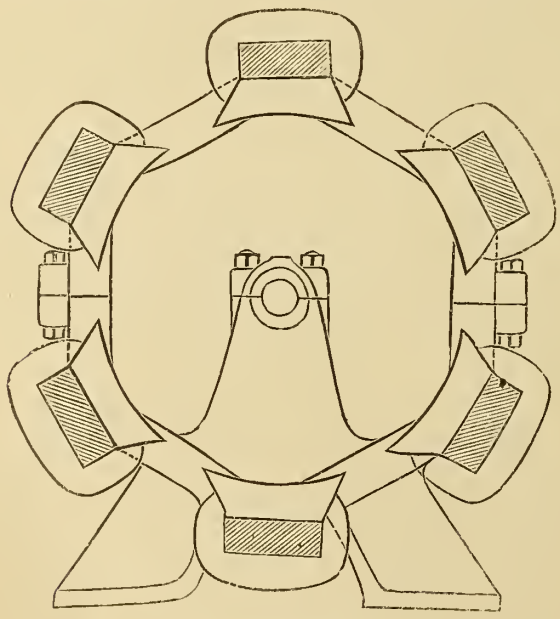


FIG. 8.

machines above mentioned. The decision as to whether cast iron or wrought iron should be used is arrived at in a very simple manner—by comparing the excess of copper required on one hand with the extra machining required on the other.

It will be observed that in the designs Figs. 5 and 6 the yokes are considerably longer than those shown in Fig. 4, and the weight of the former, if made of the same material, would be, roughly, twice that of the latter, though even then the complete magnet system would be but 75 per cent. of the weight of Fig. 3. The yokes being of cast iron, however, the system really comes about 20 per cent. heavier than Fig. 3; the less expensive character of the material compensating, of course, for the increased weight.

All these are examples of single magnetic circuits, where the lines of force from each pole remain undivided in their paths

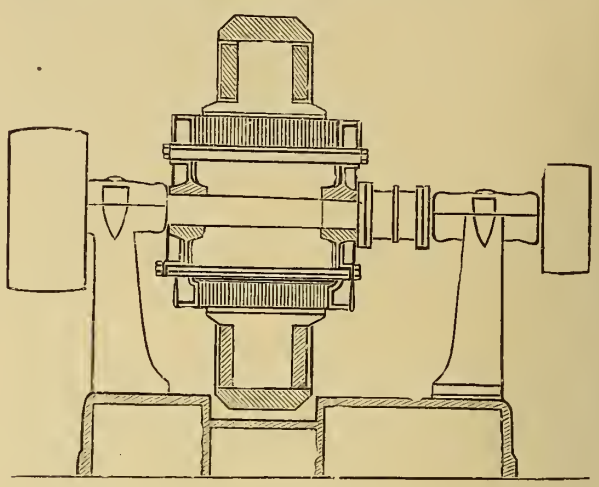


FIG. 9.

through the magnetizing coils; but in Figs. 7 and 8 are shown examples of double magnetic circuits, in which the lines from each pole take two paths through separate coils. Fig. 7 is a type of magnet used by Sautter-Lemmonier, of Paris, for Gramme-wound armatures, and by Cuenod-Sautter, of Geneve, for armatures having a Siemens winding as modified by Thury. The magnetizing coils are wound upon the parts of the system constituting in Fig. 6 the yokes, and a greater amount of copper is in consequence required. It looks at first sight as if the weight of copper was not very different in the two types, but in this respect appearances are deceptive, for, as a matter of fact, the field of a four-pole machine made according to Fig. 7 would require about 125 per cent. more copper than if made according to Fig. 6. It will be observed, however, that the magnet cores and pole pieces, which are made throughout of the softest wrought iron, are very light. In Fig. 8 the magnets are a series

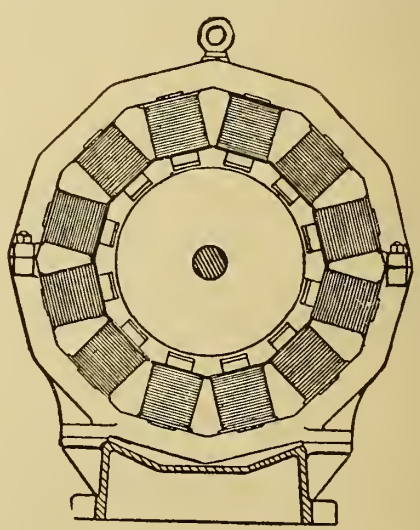


FIG. 10.

of wrought iron bars lying parallel to the armature, each fitted with a cast pole piece in the middle of its length, and having two magnetizing coils, one on each side of this piece. It is a structure which may be frequently met with, though not precisely in the form shown, and the observations regarding the copper made with reference to Fig. 7 apply equally here.

The cost of a four-pole machine is approximately represented by the cost of a couple of two-pole machines of the same efficiency, which give each half the output at twice the speed; the cost of a six-pole by that of three two-pole machines which give one-third of the output at three times the speed, and so on. For comparison, the fields must be in both the multipolar

machines and two-pole machines of the same character—that is, with single or double magnetic circuits.

The fields of alternators may be similarly divided into those having single and those having double magnetic circuits; the former requiring, as in the fields of direct current machines, much less copper than the latter. Among those having single-magnetic circuits are the machines of Siemens, Ferranti, Elwell, Mordey, Westinghouse, Parker, Paterson and Cooper. Mr. Knapp possesses the distinction of having the only alternator with double magnetic circuits. The "Phœnix" alternator, shown in Figs. 9 and 10, possesses some features which may be of interest, as illustrating the way in which the commercial aspect of designing has to be considered. The yoke-ring is of cast iron, but the magnets are of tooled wrought iron, shaped as shown. If the magnets had a breadth equal all the way up to the length of the armature core, they might as well have been of cast iron, for the little advantage consequent on the reduction of copper obtained by narrowing them would not have paid for the extra work in tooling wrought iron. But when we reduce the breadth where the magnetizing coils are, as shown, we at once diminish the copper on the fields by 60 per cent., greatly reduce the leakage area, and get a good balance after paying for extra tooling. The machine, as will be seen, has 12 radial magnets, and there are on the armature six flat coils, each equal to three times the width of the magnet cores, and laid on the periphery with a space equal to the core between them.

The length of the paper prohibits me from dealing with many special types of machines, to which, however, all the reasoning here used may be applied without difficulty.

ANNUAL CONVENTION OF THE C. A. S. E.

THE second annual Convention of the Canadian Association of Stationary Engineers assembled in Shaftesbury Hall, Toronto, on Sept. 15th, the president, A. M. Wickens, in the chair. There were present, vice-president, Mackie; secretary, G. C. Mooring; treasurer, Wm. Sutton; conductor, A. Ames.

The following delegates were in attendance: Bros. Heal and Edkins, Toronto; Bro. Thos. Ryan, Montreal, (2 votes); Bros. Nash and Langdon, Hamilton; Bro. Bate, Stratford; Bro. Geo. Mooring, Brandon. The minutes of the last Convention having been read and confirmed, the president's annual message followed.

Reports of the secretary and treasurer were read and referred to the Auditing Committee.

Bros. Ames and Dickinson reported, recommending that the property of the Association, consisting of charters, stereotype plates, etc., valued at $76.35, be paid for by a special pro rata levy. The report was adopted.

The following Committees were appointed: On "Constitution," Bros. Ryan, Heal and Mackie; on "Good of the Order," Bros. Ames, Nash and Sutton; on "Ways and Means and Auditors," Bros. Oathwaite, Langdon and Mosely.

The meeting adjourned for Committee work, resuming at 8 p.m.

The Committee on "Constitution" reported, recommending a form of constitution, which was adopted clause by clause.

The Committee on the "Good of the Order" recommended the appointment as soon as circumstances will permit, of an organizer, a liberal amount of whose time should be given to the interests of the Association in extending the branches to districts where the required number can be brought together; also the appointment by each Association of an instructor, with the object of establishing a means of obtaining correct decisions with reference to disputed subjects pretaining to questions and answers, and of results obtained under various working conditions of steam plants. The Committee also recommended the filling of situations by Association members, and that any Association not having a member to fill a position should communicate with the other Associations and obtain a man with the necessary qualifications, so that the steam user might appreciate the endeavors of the C. A. S. E. to place competent men in charge of steam plants. The report urged that the instructor and President of each Association likewise assist in preparing the members and qualifying them to take out certificates under the Ontario Act, passed April 30th last, and that it is advisable to adopt a pin, button or badge, for purposes of recognition, and that a Committee be appointed to procure a suitable design; also that all Associations be notified of any expulsions of members or rejection of candidates.

On motion, the report was adopted.

The secretary's report was audited and adopted. It showed the total number of members initiated to be 389; total amount of money received, $3,239.92; total expenses, $2,493.25; total paid out for sick benefits, $386.75. The report was adopted.

The election of officers resulted in the appointment of A. M. Wickens, as president; Thos. Ryan, past president; Robt. Mackie, vice-president; A. E. Edkins, secretary; Wm. Sutton, treasurer; Chas. Heal, conductor; Geo. C. Mooring, door keeper.

Bros. Ames, Sutton and Ryan were appointed a committee to procure a suitable badge or button to be worn by members.

The meeting adjourned until 10 a.m. Wednesday morning.

On resuming, the Committee on Constitution having furnished its report, it was adopted.

The place of next meeting was settled in favor of Hamilton, and the date chosen is the last Tuesday in August, 1892.

The Convention closed at noon.

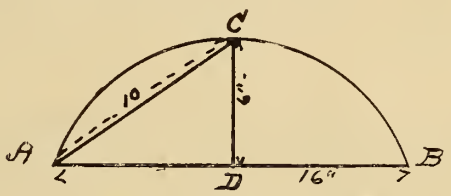
On Tuesday from 2 until 6 p.m., the delegates were under the care of the Reception Committee of Toronto No. 1. Carriages were procured and the visitors driven to the reservoir, Metropolitan Street Railroad power house, High Level Pumping Station, and School of Practical Science.

All the delegates expressed satisfaction at the work accomplished, and look forward to a prosperous year.

QUESTIONS AND ANSWERS.

Editor CANADIAN ELECTRICAL NEWS.

I NOTICE in the September number of the NEWS an enquiry from E. J. Phillips, of Toronto, as to the method of calculating the area of a segment of a circle. The following rule, which may be found in many works on engineering, and which can be easily worked out by anyone who understands decimal fractions, will give the area of the segment of a circle:



Let A C B D in the above figure represent a segment of a circle, the area of which it is required to ascertain. The curved line, or portion of the circumference, A C B, is called the arc. The straight line A B, connecting the extremities of the arc, is called the chord. The straight line C D, perpendicular to A B, and dividing the segment into two equal parts, is called the versed sine; while the straight line A C, is the chord of one half the arc A C B. The rule is:—To the chord of the arc add the chord of one-half the arc, and to this again, add the chord of one-half the arc, divided by 3; multiply the sum of these numbers by the versed sine, and this again by decimal ·4; the result is the area of the segment. To put this in the form of an equation:

Let C = the chord of the arc.

V S = the versed sine.

c = the chord of one-half the arc, then $(C + c + \frac{c}{3}) \times V S \times \cdot 4$ = area of segment of circle.

To illustrate this, we will assume that the length of the chord of the arc (A B) in the above diagram is 16 inches, the versed sine (C D) = 6 inches, and the chord of one-half the arc (A C) = 10 inches—then $(16 + 10 + \frac{10}{3}) \times 6 \times \cdot 4 = 70\cdot 4$ square inches = area of segment of circle.

To find the chord of half the arc, when chord of arc and versed sine are given: To the square of the versed sine add the square of one-half of the chord of the arc; the square root of this sum will be the chord of one-half the arc. Example—In the foregoing figure the versed sine is 6 inches: $6 \times 6 = 36$"; to this add the square of one-half the chord, which is 16"; one-half of this would be 8", and $8" \times 8" = 64"$; then $36" + 64" = 100"$; the square root of this is 10", which is the length of the chord of one-half the arc.

O. P. ST. JOHN.

Vancouver, B. C., 12th Sept., 1891.

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EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

NOTICE TO SUBSCRIBERS.

SEVERAL subscribers to the ELECTRICAL NEWS have changed their addresses of late without notifying us of the fact. In one or two instances it has been found impossible to discover their new locations. To avoid difficulty in this line, subscribers will oblige by notifying the publisher whenever they may change their address.

THE National Association of Stationary Engineers of the United States assembled in annual convention at Omaha, Neb., the first week in September. No better evidence that the Association is prospering is needed than the fact that 2,519 initiations took place during the year. The total membership is now 7,680. The proposition to amalgamate the American and Canadian Associations was disapproved of.

OUR genial friend, Mr. "Dan" Thomson, the recently appointed general manager of the Hamilton Electric Light Co., has a great scheme in his head. He says it will make that ambitious city the biggest on earth and the chief manufacturing centre on the continent. We believe the MOUNTAIN is "in it" somehow, but are not sure. We suggest that the scheme be unfolded at the first meeting of the Canadian Electrical Association, and can promise on behalf of the Toronto contingent some most interested listeners. This is a really serious scheme too, and not to be confounded with the irreverent suggestion of a member at the inaugural to wind some wire round the mountain as an armature and rub it on the north pole.

OUR contention that it is not advisable for a municipality to engage in commercial enterprises has received a strong confirmation in view of the present condition of electric light matters at Toronto Junction. It is considerably over a year ago that the council started in to purchase an electric light plant. The usual "deputations" to the United States were indulged in, with the result of mixing up the "deputies" in a worse manner than they were before. Part of them returned wedded to arc lights and the other part as determined for incandescent. The result is a lamentable mixture of the two systems with "deputations" of citizens to the council as determined to stick to gas. Work has commenced, and considerable objection is taken to the quality of some of the material by a part of the council while the other part are just as determined that it is all right. The chances are that the illumination will be an expensive business, but in any case, whoever gets the fun of dancing, the patient citizen will be expected to foot the bill for the piper.

SOME dissatisfaction appears to exist among the engineers that the position of chief at the Toronto waterworks was not thrown open to competitive examination. There is no doubt, however, that, provided the necessary qualifications are there, the plan of promotion adopted by Superintendent Hamilton was the proper one. Men who have handled the engines for years should know more about their practical working than any outsider, no matter how near his finger ends he may have the correct theory of steam, or be able to paralyze an examiner by his knowledge of algebraical equations. While we do not for a moment wish to underrate the possession of such knowledge which may be, and indeed is, indispensable to the designer and constructor, it is certain that a thorough, practical acquaintance with the particular machine in use and how to handle it and humor its idiosyncracies, would be decidedly more useful and to the point. It is reasonable to suppose that the machinists and engineers who have handled and repaired the engines for years should be competent to take a step higher when the chief difference in their duties consists in drawing a somewhat larger salary. Theory is all very well, but in the simple matter of driving a steam engine, practice also counts for a good deal. A scholar could probably demonstrate to the Italian navvy working on a drain just how the law of leverage applied to his spadeful of clay, and that the nearer the fulcrum to the load the less the weight would be, and what he gained in power he lost in time, and so forth ; but without solving this theory, the navvy in question had already solved the problem of throwing out the earth with the least trouble to himself. A test on book learning would disqualify many good engineers we know of, but its possession will no doubt enable a man to graduate from the coal shovel to a superior position in the profession.

THE question as to the cause of boiler explosions is often the subject of considerable argument and various theories are advanced in explanation of it. Some are very fine spun and involve intricate problems regarding the decomposition of water, the absorption of oxygen by the red hot plates and the liberation of hydrogen and so forth. Our idea is that a boiler explodes simply because it is unable to withstand the pressure inside it at the time. The apparent simplicity of this reason may cause a smile, but there is nothing more in it. A boiler by neglect and corrosion is gradually but surely weakened, until perhaps after hovering for weeks around the bursting point, it lets go, and disaster is the result. It is not alone in old boilers that trouble is to be feared. Some new boilers are so carelessly and unskillfully made that when the angles or flanges of the sheets are not broken by the flange turners they are cracked out by the drift pin of the riveting gang. When the holes come out of line with each other this drift pin is inserted, and the sheets are literally stretched until the rivet can be got in. It is possible that in this manner there is strain enough to severely weaken a boiler before a pound of steam is raised. Faulty design in a boiler is a prolific cause of trouble. Due attention is not paid to the liability of expansion and contraction, and this is the reason why it is impossible to keep some boilers tight. The careful and conscientious engineer will pay particular attention to his boiler He should examine the braces and the work required of them ; take off the manhole and get in the boiler and sound the braces with a hammer. Some may ring like a bell and others have the sound of a loosened cord; the latter should be shortened up. The jaws should be examined to see that they are not split or cracked. If there is scale forming on the crown sheet or flues, it should be removed. If stay or socket bolts leak they should be taken out and replaced. The flues should be clean and swept every week. Ashes should be kept away from the back ends and water legs of boilers, and if leaks occur, they should be caulked at once. It has been asserted that fibrous and flocculent material placed inside boilers will stop them from leaking, but as a leak is an evidence of weakness, it is not policy to conceal it but to strengthen it by caulking or renewing with another sheet. While the organ of weakness leading to boiler explosions may be often obscure, it is evident that certain causes produce certain effects, and that neglect and carelessness have no place around steam boilers. They should be clean inside and out, and strong as well. It is no use to put on dabs of putty to hide leaks, or fill a boiler half full of horse manure for the same purpose. The bad part should be taken out and a new one put in

to make a radical cure. Take care of the safety-valve ; try it every day, and don't have it sticking fast. If these simple rules were more attended to, there would be far less occasion to invent obscure reasons for the explosion of a steam boiler.

WE are pleased to be able to record the auspicious beginning of what we believe will be a most successful organization. We allude to the inaugural meeting of electricians and electric light men which took place during the recent Industrial Exhibition. It was in every sense a representative gathering, as it included not only those interested more directly in electric lighting and power, but also the kindred branches of electric telegraphy and telephony. It was abundantly demonstrated that there was the nucleus of a most successful Association which, in the hands of the Committee appointed, will no doubt take practical working shape. It will have the advantage of being distinctively Canadian, and will be able to handle the many problems of both the scientific and commercial application of electricity from a Canadian standpoint. The National Electric Light Association of the United States is a growing and powerful organization, but it is first and foremost, as its name implies, "National," and as the nation to which it belongs is striving to accentuate the line of demarcation between the two countries in a commercial point of view, the time appears to be opportune for Canadians to form an alliance of electrical interests on a similar plane, but which shall also be national in fact as well as name. Montreal was a "surprise party" to a number of American visitors to its Convention, who had an idea that Canada was a veritable backwoods as to its development electrically—in fact, a rich mine only waiting to be explored and developed by the American manufacturer. As a matter of fact, however, taking the number of population as a basis of comparison, there are more electric light plants than there are in the United States, and manufacturing interests on as large a scale. In the protection of these varied industries, the maintenance of a profitable method of business, and the elimination of undesirable and unfair competitive depreciators of values, there is a wide field of usefulness for an Association comprising the business element and the backbone of the industry in Canada. With these men, whose capital is necessary to extend and develop electrical discoveries, may well be associated the scientific man and the electrician—a combination that would be invincible—and thus everything newest and best in the electrical field would be brought within available reach. Apart from purely business considerations, also, the meeting together with the object in view of mutual advantage, will have a tendency to round off some of the sharp corners and arperities that have developed from undue competition, and we may hope that a better understanding will arise with the increase of friendly feeling, which will redound to the advantage of all. From a purely technical standpoint also, the formation of an Association of the electrical interests will be of great advantage to its members. An interchange of ideas ; the discussion of different methods of attaining a desired end ; the introduction of new and novel inventions ; essays and papers on subjects of interest to the craft, would tend to make its meetings both interesting and instructive to the members. It is to be hoped that the enthusiasm of the inaugural meeting will be maintained by the Committee, to whom has been entrusted the details of organization, and that a perfect and comprehensive scheme will be formulated for adoption by the general meeting which is fixed for the 26th of November next.

LOOKING forward a month ago to the approaching visit of the members of the National Electric Light Association of the United States to Canada, it was our pleasure and privilege to bid them a hearty welcome, and to express the hope that their brief stay amongst us might become so pleasureable as to incline them to repeat the visit on a future occasion. Looking back upon the Convention, it seems as though the most sanguine anticipations concerning it have been realized. Montreal has on other occasions extended her hospitality to a larger number of visitors, but it can safely be declared that never did her citizens exert themselves more energetically or successfully for this object than on behalf of the delegates to this Convention. Entertainments of a public and private character were so numerous as to leave not the ghost of a chance for a feeling of *ennui* to creep in. Indeed, those who sought to take part in all the events of a social and business character in this most eventful week were obliged to place themselves on short allowance in the matter of sleep. If, however, the citizens of Montreal left undone nothing which would ensure the pleasure of their guests, it should also be stated that they were amply rewarded by the most hearty appreciation of their efforts on the part of the visitors. Fortunately the weather was delightfully bright and warm, revealing the city and its surroundings to advantage, and tending in a most important degree to enhance the pleasure of the occasion.

Notwithstanding the busy round of social engagements, the special object of the Convention, viz., the promotion of electrical interests in the United States, was not overlooked. At the business session held each day during the week, instructive papers were read and discussions held on a variety of subjects, and important action was taken in a number of directions on behalf of the welfare of the industry. The discussion on the relations of manufacturing and central station companies, revealed the existence of a deep and widespread feeling of dissatisfaction with the conduct of many manufacturing concerns in seeking to increase their profits at the expense of their original customers by forcing competition upon them as they were beginning to realize some return from their investments. Mr. Weeks, in speaking on this subject, said : "Parent companies are selling to the gas interests—and they have the effrontery in their advertisements to boast of their success—apparatus that employs the very devices whose exclusive control has been guaranteed to the interests that the new purchasers are straining every nerve to kill." A few instances of this reprehensible practice have recently come to light in Canada, but thus far we believe they have been confined to the operations of a single concern. The feeling among members of the National Electric Light Association concerning this matter seems to be in favor of discontinuing to purchase from companies known to be guilty of a breach of faith in this particular. Meanwhile, the Association has appointed a Committee to formulate a definite plan of procedure for the protection of the central station companies.

Among other subjects to which consideration was given, may be mentioned :—Comparison of economy in the generation of power ; electrical arrangements connected with the World's Columbian Exposition, including the holding of an International Electrical Congress ; data on the prices charged for electric lighting in various cities of the United States—it being pointed out in this connection that comparisons were made showing that some municipalities were being supplied with electric light at much lower rates than others, without mention being made of the difference in the conditions under which the electric plants were operated, and which are responsible for the variations in the prices. It was a matter of regret that the Committee on Underground Conduits had not sufficient time at their disposal in which to secure the necessary data for a comprehensive report. The result of their labors will be eagerly looked for at the next Convention. An interesting discussion took place on the paper read by Mr. T. Carpenter Smith at the Providence Convention, on "The Distribution and Care of Alternating Currents." The Convention in executive session reported a series of tabulating, wiring and insurance rules, which are printed in full in this paper. Papers were read as follows : "Central Stations Operated by Water Power," by Geo. A. Redman ; "A Central Station, Combining the Advantages of both the Continuous and Alternating Systems," by H. Ward Leonard ; "Uniformity in Method of Keeping Central Station Accounts," by J. J. Burleigh ; "Three Years Development of Electric Railways," by Eugene Griffin ; "Electric Railroad Construction and Operation, and a Consideration of Their Connection with Central Station Interests," by C. J. Field ; "Some Details of the Care and Management of an Arc Light System, as Practiced by the Municipal Company of St. Louis," by J. I. Ayer ; "Different Forms of Carbons Used in Arc Lighting," by E. P. Warner. The banquet with which the proceedings closed afforded the opportunity for an exchange of the kindly sentiments which the intercourse of the week had engendered. One could discern in these expressions the ring of something deeper than the compliments of polite society—the

tones of honest admiration and sympathy. Lord Stanley fittingly expressed it when he said that "blood is thicker than water" The Convention throughout was well calculated to deepen the mutual respect existing between the people of the United States and Canada. As a proof of this it is observed that Dr. Mason has given notice of motion to amend the constitution by substituting "International" for the word "National" in the title of the Association. Notwithstanding, the resolution comes too late to check the movement in favor of a Canadian "National" Association.

The visit of the Association to Canada has served to bring before the notice of its members and of our own people the natural advantages in the way of water power, etc., which exist in this country for the profitable utilization of electric apparatus. Contact with men of such bright minds and great energy as the members of the National Electric Light Association should also benefit us by stimulating us to the accomplishment of greater things on our own behalf and that of the country to which we belong. It is to be regretted that a greater number of persons connected as owners and managers with electric plants in Canada, were not present. The electrical exhibition was a perfect success, and served as a valuable object to demonstrate to the thousands who daily visited it the almost infinite number of practical uses to which electricity is being adapted. We have only to add that the visit of our American friends has done us good, and we cherish the hope of seing them with us again if not in the immediate, at least in the not distant future.

ELECTRIC AND MAGNETIC THEORIES.*

THE medium surrounding a wire that is a part of an electric circuit is the seat of a double set of actions. Its electrical potential varies from point to point, the medium being in a state of electro-static disturbance. It is also in a state of magnetic disturbance, and its magnetic potential varies from point to point, but in a wholly different manner. For the sake of simplicity let us consider an indefinite long straight wire, through which a "current" is passing. For the sake of numerical precision, suppose the wire to have a resistance of $\frac{1}{100}$ ohm per inch, and a current of an ampere to be passing through it. Then points distant an inch apart along the wire will differ by $\frac{1}{100}$ of a volt. Select one of these points where the potential has the value, say, of 0·50 volt. Through this point consider a plane drawn so that the wire is normal to it. All points in this plane will be at the same potential ; the plane will be a surface

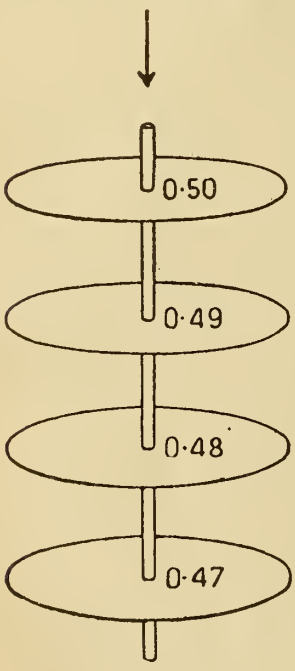


FIG. 1.

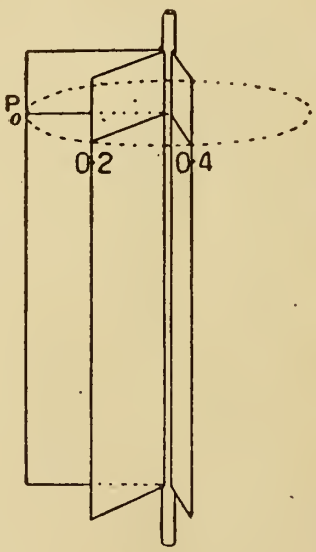


FIG. 2.

of equipotential. No energy need be spent in moving a unit of electricity from any point in this plane to any other point in it. At other points along the wire let similar equipotential surfaces be drawn, as in Fig. 1. The lines of electrostatic force will be straight lines drawn parallel to the wire, and will cross the equipotential surfaces normally. But surrounding the wire will be another system of lines and surfaces mapping out the magnetic properties. Consider any point P near the wire. On a unit magnetic pole, at a distance of r centimetres, the force due to the one-ampere current will be equal to $0.2 \div r$ dynes, and will tend to move it (as viewed in Fig. 2) clock-wise around the wire. If we push it the opposite way around we shall do work upon the unit, and when we have pushed it once completely round the wire we shall have done $2n \times 0.2$ ergs of work ; or to move it through an angle of one radian ($= \frac{1}{2}n$ of a circumference) will require an expenditure of 0.2 ergs of energy. A plane drawn through P and the wire will be a plane in which all points are at the same magnetic potential. A system of such magnetic equipotential surfaces may be drawn around the wire ; they will be set radially, at equal angles apart, reckoning from the zero position. For the current of 1 ampere the angle between surfaces that differ by $\frac{1}{10}$ of a unit of magnetic potential will be equal to $\frac{1}{4}n$. Now, imagine these two systems of surfaces to be superposed. The intersections of the electrostatic

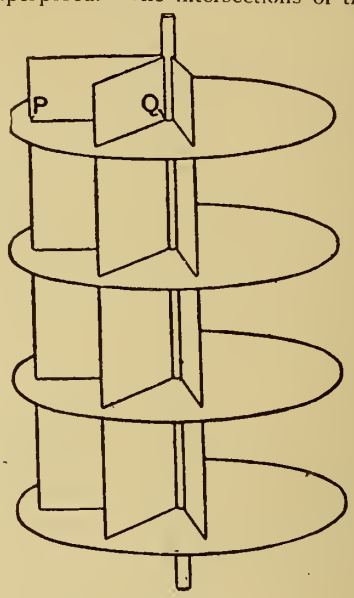


FIG. 3.

equipotential surfaces with the magnetic equipotential surfaces will be a set of radial *lines* (Fig. 3). Now consider what would happen if we had to move either a unit of electricity or a unit magnetic pole along one of these lines, such as P Q. Because the line is in a surface of electrostatic equipotential, no work would be done along the line in question in moving a unit of electricity along it and because it lies in a surface of magnetic potential, no work would be done in moving a magnetic pole along it. Now, according to Poynting's view, it is precisely along such lines as these—the intersection of the static and magnetic equipotential surfaces—that the electro-magnetic energy flows. It is the only path compatible with the condition that the energy in crossing the medium shall not either add anything or take anything away from the energy already existing in the medium. If it were to leave this line and pass either to a point of higher or lower potential in the medium, this would alter the state of the medium and change the configuration of the electrostatic and electro-magnetic stresses in it. That is, of course, exactly what happens during the time when an electric current is starting, during the variable period, while energy is being poured out into the medium to throw it into the peculiar state at the beginning. But we have been dealing here with the question of steady flow.

Again, in the case of alternating currents setting up alternating electromotive forces across the medium in another circuit, during part of the oscillation some energy is being thrown outwards into the medium simply to set up stresses and some more energy is actually crossing by the paths so set up into the second circuit, and during another part of the oscillation the energy that was momentarily resident in the medium is re-entering the source to be again thrown out. Doubtless the energy paths are of somewhat complex form in all these cases ; that is no reason why their real existence should be held doubtful. Take a single case. Consider a system of circuits with two interposed transformers ; one transforming from a primary circuit into a secondary, the other transforming from the secondary circuit into a tertiary. How complex must be the paths here along which the energy flows, even if one confines one's attention solely to those parts of the circuits where the transformations are taking place.

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*Abstract of a paper read by Silvanus P. Thompson, London.

TORONTO BRANCH NO. 1, C.A.S.E.

At the last regular meeting of the above branch, held on Friday evening, 25th inst., a very profitable time was spent. After routine business, considerable discussion took place on the different methods and formulas as given in the text books for computing the height of columns of water which would be equal to given pressures per sq. in. at the base. Bro. C. Heale, Chief Engineer at the High Level Pumping Station, gave some valuable "pointers" on the blackboard.

A pleasant event in the evening's proceedings was the presentation of three books on Mechanical Engineering to Bro. Walter Blackgrove, as a slight token of appreciation of his energetic work as Secretary for the past three years. The presentation, accompanied by a few deservedly eulogistic remarks, was made by President A. E. Edkins. Bro. Blackgrove, in response, thanked his brother engineers for their kindness, and assured them that as long as he was blessed with health he would gladly serve the Association in any capacity.

One new member was admitted, and three propositions received.

A committee was appointed, consisting of Bro. W. Sutton, W. Lewis, S. Thompson, A. M. Wickens and W. Oathwaite, to make necessary arrangements for the annual dinner, which will take place in November.

CANADIAN ELECTRICAL ASSOCIATION.

PURSUANT to the announcement published in the ELECTRICAL NEWS for September, a meeting was held in the offices of the Industrial Exhibition Association, Toronto, on Thursday afternoon, Sept. 17th, to informally discuss the desirability of organizing an association which should be representative of the electrical interests of the country.

The following gentlemen were in attendance:

J. J. Wright, manager of the Toronto Electric Light Co.; George Black, manager G.N.W. Telegraph Co., Hamilton; John Yule, manager Guelph Gas Co.; I. C. McLachlan, Hamilton, representing Edison Co.; J. D. McDiarmid, Aylmer, Ont.; S. Douglas, Kay Electric Works, Hamilton; A. T. Anderson, 75 Adelaide St. east, Toronto; Richard Mitchell, vice-president of the Guelph Gas & Electric Light Co.; H. H. Powell, secretary Woodstock Electric Light Co.; W. A. Tower, superintendent underground work, Bell Telephone Co., Toronto; J. A. Baylis, electrician, Bell Telephone Co., Toronto; J. Norman Smith, electrician, Ball Electric Light Co.; W. A. Johnston, general manager Ball Electric Light Co.; D. Thomson, general manager Hamilton Electric Light & Power Co.; J. W. Taylor, Brooks Manufacturing Co.; J. Braden, traveller for the Brooks Manufacturing Co., Peterboro'; J. Telfer, Blenheim, Ont.; C. A. Phillips, Midland, Ont.; H. Brown, St. Thomas Gas & Electric Light Co.; C. H. Mortimer, publisher The ELECTRICAL NEWS; A. B. Smith, Inspector of Electric Lighting Board of Underwriters.

On motion of Mr. Yule, Mr. J. J. Wright was asked to preside over the proceedings, Mr. C. H. Mortimer being chosen to act as secretary.

The Secretary read the following letter:

611 & 612 ELECTRICAL EXCHANGE.

NEW YORK, Sept. 9th, 1891.

To the "~~Canadian Institute of~~ Electrical Engineers" Greeting:

On 15th April, 1884, pursuant to a call issued a few days previous a few gentlemen met, by the courtesy of the American Society of Civil Engineers, in their rooms "for the organization of a National Electric Society." This association became the American Institute of Electrical Engineers, with a membership at the end of its eighth year (May 19, '91) of five hundred and forty-one (541). The Institute, as you know, stands to-day as the representative of our profession in the United States. You, gentlemen, are assembled to form just such another association for the great Dominion of Canada, the sister of the United States, although there are many of us who hope she may some day relent and cease to be a "sister to us," only that our mutual interests may be made the closer thereby.

While Canadians chiefly are gathered at this time, your call has sounded "afar off," and there are many friends with you in spirit who would have been glad to be with you in person at this time, and to whom the prosperity of the new society will be of deep concern. As one of such, permit me, with congratulation that the advances of electrical engineering have brought you thus into a nearer bond of fellowship to the mutual advantage of all concerned, to salute you, one and all, severally and unitedly, and may "God speed" the good work you have undertaken.

Cordially and fraternally yours,

J. STANFORD BROWN.

Letters of regret at inability to attend the meeting and expressive of best wishes for the successful formation of a Canadian Electrical Association, were read from Mr. Frederic Nicholls, manager Toronto Construction & Electrical Supply Co., and from Mr. E. F. Clements, of Yarmouth, Nova Scotia.

The Chairman invited an expression of opinion as to the lines upon which the proposed Association should be organized.

Mr. Taylor thought the Association should embrace all branches of the electrical industries.

Mr. Johnston concurred in this view.

Mr. McLachlan thought the Association should conserve the commercial interests of the electrical industries.

Mr. Thomson moved, seconded by Mr. Douglas, that a committee be appointed, consisting of Messrs. Wright, Nicholls, Thomson, Johnston, Smith, Dunstan and Yule, to formulate a scheme of organization, and report at a future meeting. Carried.

Mr. Thomson moved, seconded by Mr. McLachlan, that the meeting to receive the report of this committee be held on Thursday, November 26th, at a time and place to be fixed by the committee, and of which due notice shall be given. Carried.

It was decided that a meeting of the Committee on Organization should be held, in the offices of the Toronto Electric Light Co., on Monday, Sept. 28th.

The following letter came to hand after the date of the above meeting:

646 CRAIG STREET,
MONTREAL, Sept. 9th, 1891.

Editor ELECTRICAL NEWS.

DEAR SIR,—Re formation of a Canadian Electrical Association, I note Mr. M. D. Barr's letter in regard to former society of that name existing in Montreal. As late secretary of said society I may state, that for various causes it no longer exists, and the monthly meetings were discontinued some time ago. Although lack of time does not permit my being present at the formation of the new Association, yet I should be happy to forward its interests.

Yours very truly, WM. B. SHAW,
Electrician with T. W. Ness.

The Committee on organization met at the appointed time and place.

There were present Messrs. J. J. Wright, D. Thomson, W. A. Johnston, —— Dunstan, John Yule, A. B. Smith and the Secretary, C. H. Mortimer. Mr. J. J. Wright was requested to preside.

After full discussion, it was decided that the organization should be named the Canadian Electrical Association, and that its object should be to foster and encourage the science of electricity, and promote the interests of those engaged in any electrical enterprise.

The Committee will recommend that the membership consist of active and associate members—the former to include all persons actively engaged in electrical business, who shall be entitled to vote at all meetings of the Association; and the latter, all those interested or actively engaged, who shall be entitled to attend all meetings, except those of the Executive, and take part in all discussions, but shall not be entitled to vote. It is recommended that honorary members may be elected by a two-thirds vote of the Association.

There will, of course, be a difference in the membership fee, as between active and associate members, corresponding to the value of their respective privileges.

In the judgment of the Committee the officers should consist of: President, two Vice-Presidents, a Secretary and Treasurer, who may be one person, and an Executive Committee consisting of nine members, together with the President and two Vice-Presidents, five of whom should form a quorum.

The suggestion was made that a Legislation Committee would be a valuable adjunct to the Association. Its appointment will devolve upon the Executive Committee.

The Secretary was instructed to issue a circular to persons in charge of electric light, power, telephone and telegraph stations throughout the Dominion, setting forth what is proposed to be done, and inviting their active co-operation in behalf of the enterprise.

The meeting was a most enthusiastic one. In fact, the more the undertaking is discussed, the greater appears the need for such an organization as the one proposed, and the deeper becomes the interest of those who have thus far lent their assistance.

It is earnestly hoped that representatives of the electrical industries in all parts of Canada will give the undertaking a helping hand.

ENGINEERS AT THE MONTREAL CONVENTION.

Editor ELECTRICAL NEWS.

THE recent convention of the National Electric Light Association in Montreal has come and gone, but remaining are many pleasant reminiscenes for those of us who were fortunate enough to be present. It goes without saying that our American cousins were agreeably disappointed. Many of them had the haziest of ideas concerning our Canadian people, our salubrious climate, our beautiful scenery, and last, but not least, the perfection and substantial character of our electrical establishments.

The newspaper man from over the border was there galore. From all appearances Canadian air has a very good effect on him, and if he would bide with us a little, he would return home with his ideas so refashioned that he would deride McKinley and his little bill as much as is done on this side of the line. Canadian institutions can and do thrive well on a McKinley freeze out.

Among others whom I had the pleasure of meeting in Montreal was P. G. Monroe, of the *Stationary Engineer*, and Wm. Swetland, of *Steam Power*. What they were fooling around with electricity for, passes all understanding. However, the Montreal members of the C.A.S.E. called a special meeting and engaged carriages in order that the visitors might see and meet some of the Canadian engineers.

The chair was taken by Bro. Hunt, of Montreal No. 1, and kind words of welcome expressed.

Mr. Swetland, being in a hurry to have a share in the festivities at the Windsor banquet, spoke first, expressing his surprise at our Canadian institutions, and his desire for the fullest and freest possible intercourse between the two nations.

P. G. Monroe was then called upon, but declined to say anything until after Bro. Wickens, of Toronto, had spoken.

Bro. Wickens gave an outline of the work of the C.A.S.E. from its inception, and also explained the position of the C.A.S.E. in regard to the recent amalgamation scheme. This was apparently what Mr. Monroe was waiting for, as he at once started to "rip us up the back." Fortunately for us, however, his good nature had dulled the knife, so that it did not cut very deeply.

Montreal No. 1 then made honorary members of the visitors. Bro. Monroe, after having thanked them for the honor conferred, gave a good common-sense talk on the subject of the good to be derived from such societies as the N.A.S.E. and C.A.S.E.

After adjournment, the members repaired to a neighboring restaurant and spent a social hour.

N. GINERE.

SAFETY VALVES—THEIR HISTORY, ANTECEDENTS, INVENTION AND CALCULATION.

BY WILLIAM BARNET LE VAN.

(Continued from August number.)

Example 10.—A safety valve of the following dimensions, to find the weight W in pounds?

L=length of long lever in inches 40
l=length of short lever in inches 4
A=area of valve in square inches 5
p=the steam pressure in pounds per square inch 100

Then by formula 11 : $$W=\frac{A\,p\,l}{L}$$

Weight $$W=\frac{5\times 100\times 4}{40}=50 \text{ pounds.}$$

Example 11.—A safety valve of the following dimensions, at what pressure p per square inch will it blow off?

W=the weight in pounds 10
L=the long lever in inches 24
l=the short lever in inches 2
A=the area of the valve v in square inches 3

Formula 12 : $$p=\frac{W\,L}{A\,l}$$

Pressure $$p=\frac{10\times 24}{2\times 3}=40 \text{ pounds per square inch.}$$

Example 12—A safety valve of the following dimensions, how long must the long lever L be to blow off at 80 pounds?

A=the area of the valve v in square inches 4
W=the weight in pounds 30
l=the short lever in inches 3
p=steam pressure in pounds per square inch 80

Formula 13 : $$L=\frac{A\,p\,l}{W}$$

Long lever $$L=\frac{80\times 4\times 3}{30}=32 \text{ inches.}$$

Lever safety valves, as generally made, are easily altered, and thus prevented from operating correctly. The lever arm a of a safety valve should always be of a length suitable for the maximum pressure the boiler is to carry; or the weight secured to the lever arm a at the proper working distance, and to prevent overloading only *one weight* shou'd be allowed on the lever arm a, and this placed at the end of the same.

EFFECTIVE AREA OF SAFETY VALVES.

The *effective area* is the opening for the flow of steam, due to the height of lift of the valve. It is an annular opening, the area of which may be found by the following rules:

Valve-Sit Notations.

Æ represents the effective area of the annular opening through which the steam escapes.
h represents vertical height in inches equal to the lift of the valve.
D represents the inner diameter of the valve sit in inches.
d represents the depth of the valve sit in inches.
v represents the angle of the valve sit to the plane of the valve.
n represents the circumference of a circle whose diameter D=1, and stands for 3.14159265.
Cos represents the cosine or the sine of the completement of the angle of the valve sit.
Sine represents the sine of the angle of inclination.
Tan represents the tangent of the angle or bevel of the valve sit.

For safety valves with flat sit, Fig. 14 gives an opening, when lifted, equal

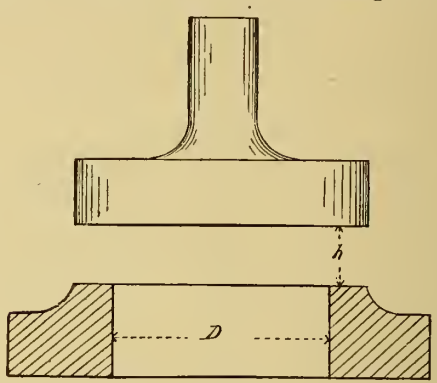


FIG. 14.

Lift of valve one-quarter of the diameter. Flat sit.

to the surface of a cylinder having the same diameter D, as that of the valve, and a height equal to the lift h.

The effective area Æ of the annular opening, when there is no bevel to the valve, will be

$$Æ=h\,n \quad \ldots\ldots 14$$

Rule.—The effective area equals the vertical lift h, multiplied by the circumference n, when there is no angle, or

$$Æ=D\,h\,3.1416 \quad \ldots\ldots 15$$

Rule.—The effective area equals the diameter D, multiplied by 3.1416, and this product by the vertical lift h.

Example 13.—A flat valve sit (Fig. 14) without bevel, with D=2 inches, and lift h=1-16 or 0.0625 of an inch. What is the effective area Æ of the opening?

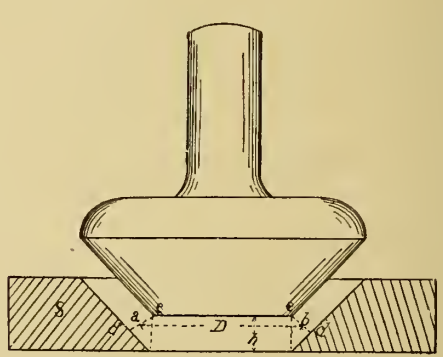


FIG. 15.

Lift of valve, half the depth of sit. Angle of sit, 45 degrees.

Formula 14 : $Æ=h\,n$

Effective area $Æ=0.0625\times 6.283=0.3927$ square inches.

Formula 15 : $Æ=D\,h\,3.1416$.

Effective area $Æ=2\times 3.1416\times 0.0625=0.3927$ square inches.

In the case of a valve sit with an angle or bevel v, Fig. 15, it is clear that the effective area Æ of the annular steam passage will he equal to the surface of a frustrum of a cone, and is the perpendicular distance $d\,e$, multiplied by the mean circumference of the diameter $a\,b$.

The distance $a\,b=D+\frac{1}{2}\,h$, which, multiplied by n, gives the circumference; or, $n\,(D+\frac{1}{2}\,h)$, when the angle v is 45 degrees.

Rule.—Multiply 3.1416 by the sum of the diameter D, added to one-half the vertical height h, when the angle, or bevel v, is 45 degrees.

For any other angle use formula 16.

The distance $d\,e=h$ cosine v. That is to say, that the distance $d\,e$ equals the vertical height h, multiplied by the cosine of angle v.

$$Æ=n\,h\cos v\,(D+\tfrac{1}{2}\,h \text{ sine } 2\,v) \quad \ldots\ldots 16$$

Rule.—First, to the diameter D of the valve, add one-half the vertical lif

h, and multiply this sum by the sine of twice the angle v; second, multiply the circumference n of the valve by the vertical lift h, and by the cosine of the angle v; third, multiply the first product by that of the second, and the result will be the effective area of the annular opening in square inches.

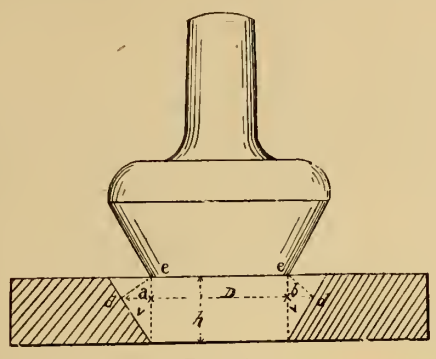


FIG. 16.

Lift of valve, the depth of sit. Angle of valve sit, 60 degrees.

Example 14.—A safety valve having a diameter D=2 inches, and the valve sit has an angle v=25 degrees. What will be the effective area of the annular opening for a vertical lift h=¼, or 0.25 of an inch?

Formula 16 : $Æ = n\ h \cos v\ (D + \frac{1}{2} h \sin 2\ v)$

Effective area $Æ = 3.1416 \times 0.25 \times 0.906\ (2 + \frac{0.25}{2} \times 0.766) = 1.157$

square inches; or,

First, $2 \times \frac{0.25}{2} \times 0.766 = 1.627.$

Second, $3.1416 \times 0.25 \times 0.906 = 0.7115$

Third, $1.627 \times 0.7115 = 1.157$ square inches.

Care must be taken in not confusing 2 v, or double the angle v, with 2 sine or double sines.

It will be seen in the above example that the angle v=25 degrees, 25×2 =50 degrees, and the sine of which equals 0.766 (see table). The following is a simple formula for a valve sit of an angle of 45 degrees, and lift h, less than depth of sit.

$Æ = 2.22\ h\ (D + \frac{1}{2} h)$ 17

Rule.—Multiply the number 2.22 by the lift h, and by one-half the lift h added to the diameter D, the product will be the effective area Æ, in square inches.

Example 15.—What will be the effective area Æ of the annular opening of a valve having a diameter D=2½ inches, for a lift h=½ or 0.5 of an inch, the angle v of valve sit being 45 degrees?

Formula 17 : $Æ = 2.22\ h\ (D + \frac{1}{2} h)$

$Æ = 2.22 \times 0.5 \left\{ 2.5 + \frac{0.5}{2} \right\} = 3.05$ square inches.

or, number	2.22
multiplied by vertical hight h	0.5
and this product multiplied by	1.110
the diameter D=2.5 plus $\frac{0.5}{2}$ =	2.75
Total square inches	3.0525

The following simple formula will also answer for angles of 30 degrees, with a lift less than the depth of the sit:

$Æ = 1.57\ D\ h + 0.68\ h^2$ 18

Rule.—First, multiply the diameter of the valve D by the vertical lift h,

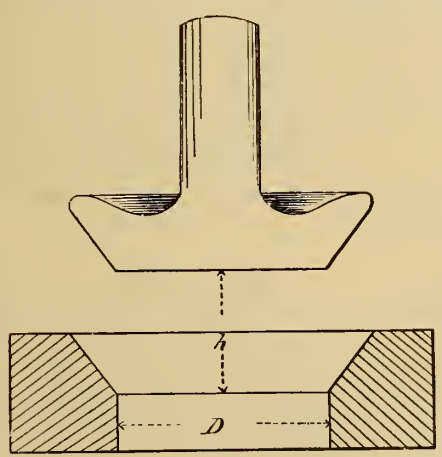


FIG. 17.

Lift of valve exceeding depth of sit. Angle of valve sit, 45 degrees.

and by the number 1.57; second, multiply the square of the vertical lift h by the number 0.68, and add the two products together.

Example 16.—What will be the effective area of a safety-valve diameter D=2 inches, having an angle v=30 degrees, and the vertical lift h=⅛ or 0.0125 of an inch? What will be the effective area of the annular opening for a lift h=1-16, or 0.0625 of an inch?

Formula 18 : $Æ = 1.57\ D\ h + 0.68\ h^2$

Effective area $Æ = 1.57 \times 2 \times 0.0625 + 0.68 \times 0.0625 \times 0.0625 = 0.199$ sq. in.;

or $1.57 \times 2 \times 0.0625$ =	0.196250
and $0.0625 \times 0.0625 \times 0.68$ =	0.003656
Effective area in square inches	0.199912

The Special Committee of the Board of Supervising Inspectors of Steam Vessels of the United States on safety valve tests at the Washington navy yard, in September, 1875, made use of the following formula. All the safety valves on trial had valve sits at an angle of 45 degrees:

$Æ = D + \frac{1}{2} h\ 3.1416\ h \times 0.71$ 19

Rule.—First, to the diameter D of the valve add one-half the vertical lift h; second, multiply this sum by 3.1416, and this multiplied by the product of lift h, multiplied by the number 0.71, gives the effective area.

Example 17.—A safety valve has a valve diameter D=2 inches, and a lift h ½ or 0.5 inch, the angle v=45 degrees, what will be the effective area of the annular apening?

Formula 19 : $Æ = D + \frac{1}{2} h\ 3.1416\ h \times 0.71$

Effective area $Æ = 2 \frac{0.5}{2} \times 3.1416 \times 0.5 \times 0.71 = 2.5$ square inches.

In case the lift h of the valve exceeds the depth of its sit, the area of excess of lift h is obtained as follows: Multiply the diameter D by the additional lift h, and by the circumference n=3.1416; this will be the area opening due to lift h above the valve sit, in square inches. Add this area to that due to the depth of the valve sit, and it will give the total effective area Æ, in square inches.

Example 18.—The diameter of a safety valve D=4 inches, and the angle v=45 degrees, and the depth of sit ⅛ or 0.125 inches, what is the area of the annular opening for a lift of ¼ or 0.25 of an inch?

First, calculate the area of opening for a valve v=45 degrees, for a lift h =⅛ or 0.125.

Formula 17 : $Æ = 2.22\ h\ (D + \frac{1}{2} h)$

Effective area $Æ = 2.22 \times 0.125 \left\{ 4 + \frac{0.125}{2} \right\} = 1.124$ square inches.

Second, calculate the amount of opening due to the lift h above the sit, which, in this example, is h 1-8 or 0.125 of an inch.

Formula 20 : $Æ = D\ h\ 3.1416$

Effective area $Æ = 4 \times 0.125 \times 3.1416 = 1.570$

Third, add these values together:

Effective area due to lift above valve sit	1.570
Effective area due to lift to top of valve sit	1.124
Total effective area in square inches due to ¼ inch lift=	2.694

THE VALUE OF THE SINES, COSINES AND TANGENT ANGLES, FROM 20 TO 60 DEGREES.

Angle.	Sine.	Cosine.	Tangent.	Angle.	Sine.	Cosine.	Tangent.
20°	.342	.940	.364	41°	.656	.755	.869
21°	.358	.934	.384	42°	.669	.743	.900
22°	.375	.927	.404	43°	.682	.731	.933
23°	.391	.921	.424	44°	.693	.719	.966
24°	.407	.914	.445	45°	.707	.707	1.000
25°	.423	.906	.466	46°	.719	.695	1.036
26°	.438	.899	.488	47°	.731	.682	1.072
27°	.454	.891	.510	48°	.743	.669	1.111
28°	.469	.883	.532	49°	.755	.656	1.150
29°	.485	.875	.554	50°	.766	643	1.192
30°	.500	.866	.577	51°	.777	.629	1.234
31°	.515	.857	.601	52°	.788	.615	1.279
32°	.530	.848	.625	53°	.798	.607	1.327
33°	.545	.839	.649	54°	.809	.588	1.376
34°	.559	.829	.675	55°	.819	.573	1.428
35°	.574	.819	.700	56°	.829	.550	1.482
36°	.588	.809	.727	57°	.838	.544	1.540
37°	.602	.799	.754	58°	.848	.530	1.600
38°	.616	.788	.781	59°	.857	.515	1.664
39°	.629	.777	.810	60°	.866	.500	1.732
40°	.634	.766	.839				

DIAMETER OF SAFETY VALVES.

The effective area Æ of the valve being known, and the height or lift h, the diameter can be calculated as follows: For a valve sit without bevel

$D = \frac{Æ}{h\ 3.1416}$ 20

Rule.—Multiply the lift h of the valve by the number 3.1416, and divide the area of opening by the product.

Example 19.—A safety valve having an effective area Æ=0.3927 when the valve lifts h—1-16th or 0.0625 of an inch. What should be its diameter:

By formula 20:

Diameter $D = \frac{0.3927}{0.0625 \times 3.1416} = 2$ inches.

or,

Number	3.1416
Multiplied by lift	0.0625
	0.19635

$\frac{0.3927}{0.19635} = 2$ inches.

Having given, the effective area Æ, formula 16, and the height h lifted, the diameter D is found from the above formula as follows:

$\frac{Æ}{n\ h \cos v} - D + \frac{1}{2} h \sin 2\ v$; of which the

diameter $D = \frac{Æ}{n\ h \cos v} = \frac{1}{2} h \sin 2\ v$ 21

(To be Continued.)

A HANDY WIRING TABLE.

By H. R. Leyden.

This table is arranged to show the size of wire for all the various low potentials and percentages of loss used in practical electric lighting and for 500-volt motor and electric railway circuits. It is calculated on the assumption that the conductivity of commercial copper wire is .97 of the conductivity of pure copper, according to the Matthiessen standard. It is also assumed that the cross-section of wire doubles with every three sizes of Brown & Sharpe gauge, which, though not absolutely correct, is sufficiently accurate for practical work. The safe-carrying capacity is taken as four-tenths of the current required to heat underwriter's insulated wire to 212° Fahrenheit in air, or seven-tenths of the current required to bring it to the same temperature when placed in moulding.

The manipulation of the table is very simple; for example, suppose we wish to carry 40 amperes 300 feet from the centre of distribution at 100 volts and 5 per cent. loss. From "40" in the column for "300 feet" cross laterally to the column headed "5 per cent. loss" at "100 volts," and we have the size of conductor as No. 3 B. & S. gauge.

The table is calculated for even percentages of loss at 100 volts. For 110 and 220 volts the percentages are fractional, but, by taking the nearest fractional percentage below the required one, the error is always on the safe side. For example, suppose we wish to carry 10 amperes 75 feet at 110 volts and 2 per cent. loss. From "10" in the column for "75 feet" cross to the column headed "1.8 per cent. loss" at "110 volts," and we have No. 11 B. & S.

Or, suppose we wish to carry 60 amperes 100 feet at 220 volts and 2 per cent. less loss. From "62" in the column for "100 feet" cross to the column headed "1.8 per cent." at "220 volts," and we have No. 5 B. & S.

For 500 volts the table does not indicate above 2 per cent. loss; but higher losses and greater distances can readily be estimated by remembering that the cross-section varies inversely with the loss, and directly with the distance. In taking the size of wire from the table, care should always be taken not to exceed the safe-carrying capacity of the conductor.—*Electrical Engineer, N. Y.*

	.2	.4	.5	.63	.8	1.	1.3	1.6	2.	% Loss at 500 Volts.
	.45	.9	1.13	1.43	1.8	2.27	2.86	3.6	4.54	% Loss at 220 Volts.
.25	.5	1.	1.25	1.57	2.	2.5	3.15	4.	5.	% Loss at 200 Volts.
.45	.9	1.8	2.27	2.86	3.6	4.54	5.7	7.3	9.1	% Loss at 110 Volts.
.5	1.	2.	2.5	3.15	4.	5.	6.3	8.	10.	% Loss at 100 Volts.
1.	2.	4.	5.	6.3	8.	10.	12.6	16.	20.	% Loss at 50 Volts.

Figures at top of column: distance in feet from centre of distribution current in amperes given below.

										25	50	75	100	150	200	300	400	500	600	700	800	900	1000
10	13	16								9	5	3	2	1									
9	12	15	16			Size of Wire				12	6	4	3	2	1								
8	11	14	15	16		B. & S. Gauge				15	8	5	4	3	2								
7	10	13	14	15	16					19	10	6	5	3	2	1							
6	9	12	13	14	15	16				24	12	8	6	4	3	2	1						
5	8	11	12	13	14	15	16			31	15	10	8	5	4	2	2	1					
4	7	10	11	12	13	14	15	16		38	19	13	10	6	5	3	2	2	1				
3	6	9	10	11	12	13	14	15	16	49	24	16	12	8	6	4	3	2	2	1	1		
2	5	8	9	10	11	12	13	14	15	62	31	20	15	10	8	5	4	3	2	2	2	1	1
1	4	7	8	9	10	11	12	13	14	77	38	26	19	13	10	6	5	4	3	2	2	2	2
0	3	6	7	8	9	10	11	12	13	97	49	32	24	16	12	8	6	5	4	3	3	3	2
00	2	5	6	7	8	9	10	11	12	123	62	40	31	20	15	10	8	7	5	4	4	3	3
000	1	4	5	6	7	8	9	10	11	154	77	52	38	26	19	13	10	8	6	5	5	4	4
0000	0	3	4	5	6	7	8	9	10	195	97	65	49	32	24	16	12	10	8	7	6	6	5
	00	2	3	4	5	6	7	8	9		123	82	62	40	31	20	15	14	10	9	8	7	6
	000	1	2	3	4	5	6	7	8		154	104	77	52	38	26	19	16	13	11	10	8	8
	0000	0	1	2	3	4	5	6	7		195	130	97	65	49	32	24	20	16	14	12	11	10
		00	0	1	2	3	4	5	6			164	123	82	62	40	31	25	20	18	15	14	12
		000	00	0	1	2	3	4	5			208	154	104	77	52	38	31	26	22	19	17	15
		0000	000	00	0	1	2	3	4			220	195	130	97	65	49	39	32	28	24	22	19
			0000	000	00	0	1	2	3				220	164	123	82	62	49	40	35	31	27	24
				0000	000	00	0	1	2					208	154	104	77	62	52	44	38	34	31
					0000	000	00	0	1					220	195	130	97	78	65	56	49	43	39
						0000	000	00	0						220	164	123	98	82	70	62	54	49
							0000	000	00							208	154	123	104	88	77	69	62
								0000	000							220	195	155	130	112	97	87	77
									0000								220	195	164	140	123	109	98

Feet. Current in Amperes.

Size of Wire B. & S.	0000	000	00	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Safe Current, Amp.	220	190	165	140	120	102	87	73	62	54	47	40	34	28	25	21	17	14	11	8

The Leyden Handy Wiring Table.

PERSONAL.

Mr. Geo. Mooring, engineer at Messrs. Alexander & Kelly's mills at Brandon, Man., and a member of the C. A. S. E., paid a flying visit to Toronto a few days ago, remaining long enough, however, to make the final arrangements in connection with a life-partnership agreement entered into with one of the fair daughter's of the Queen city. Mr. Mooring and his bride carry with them to their Northwest home the best wishes of numerous friends in Ontario.

We publish elsewhere a letter from Mr. O. P. St. John, of Vancouver, late of Toronto, in reply to an enquiry by one of our subscribers. In a letter to the editor; Mr. St. John states that he is much pleased with British Columbia, is prospering and in good health, and desires to be kindly remembered to his friends among the engineers of Ontario. There are many of our readers who carry about with them kiadly recollections of Mr. St. John, and who will join in reciprocating his kindly greetings.

RECENT CANADIAN PATENTS.

No. 37118. Geo. L. Foote, Electric Signal.
No. 37127. Wm. W. Savage, Holder for Electric Lamp.
No. 37135. Chas. W. Hazeltine, Arc Lamp.
No. 37137. W. F. Wellman, Antifriction Bearing.
No. 37152. D. G. Weems, Electric Railway.
No. 37162. P. Decker, Electrical Insulator.
No. 37166. Jas. Jos. Bush, Steam Generator.
No. 37186. T. D. Bottome, Incandescent Electric Lamp.
No. 37188. W. C. Bryant, Incandescent Lamp Socket.
No. 37198. T. L. Kay, Storage Batteries.
No. 37219. Scotch Yoke for Steam Engine.
No. 37229. E. Howland, Portable Steam Boiler.
No. 37,230. E. Howland, Boiler and Engine.
No. 37,249. Ed. Mather, Furnace Grate.

SPARKS.

Mr. Fred. Stark, late of Listowel, has been appointed assistant engineer of the electric light station at Mitchell.

The Edison General Electric Company will establish an arc and incandescent lighting plant in the town of Lindsay, Ont.

Prof. Galbraith has received his first instalment of electrical instruments for the electrical engineering department of the School of Practical Science, and hopes to have his department fully equipped in a few weeks.

The city of Chicago has introduced in its telephone exchange a very useful "busy call," which enables a caller-up of a "busy" line to have his call placed on record, so that it will have attention as soon as the line is clear.

The Montreal Exhibition Association, as well as the citizens of that city, are to be congratulated upon the success which crowned their efforts in connection with the recent exhibition. The total receipts amounted to upwards of $50,000.

The Hamilton Light and Power Company is going to spend $30,000 or $40,000 in improving its system. Work has been commenced on a new power station at the corner of Main and Catharine streets. New dynamos, two new twin engines of 600 horse power each and other new plant will be added.

The agreement between the Bell Telephone Co. and the city of Toronto, which provides for a reduction in rates to $45 per year for business premises and $25 per year for residences, and the payment into the city treasury of 5 per cent. of the gross earnings of the company in the city, has been consummated. The city grants the company an exclusive franchise for five years.

Isaac Newton is said to have carried in his ring a magnet weighing but 3 grains, which could raise 746 grains or 250 times its own weight. This magnet naturally excited much admiration, but is surpassed in power by that formerly belonging to Sir John Leslie, and now in the Physical Collection at Edinburgh, weighing 3½ grains, and having a carrying power of 1,560 grains.

Prof. Elihu Thomson has recently devised a method of case-hardening iron or steel by means of the heat produced by the passage of an electric current. His process consists essentially in heating the object electrically, and then applying to the metal so heated a surrounding envelope—either gaseous, fluid or solid—for the purpose of changing or preventing change in the quality of the material, according to the special end to be attained.

Mr. B. J. Throop, who has been local manager for ten years past of the Bell Telephone Co.'s business at London, Ont., has been appointed to fill a similar position at Hamilton. Mr. S. J. T. Brown, of Hamilton, replaces Mr. Throop at London. The staff of the London office presented Mr. Throop on the eve of his departure with a kindly worded address, a couple of easy chairs, and a marble clock, in token of their appreciation of his character.

Mr. A. A. Cross, in a brief note to the *American Machinist*, thus describes a form of commutator smoother which he has found to answer the purpose: It is simply a block of maple, with a handle like a square chisel mallet, with a semi-circle cut in outer end of block, the circle to fit the commutator. Lay a piece of fine emery cloth in the semi-circle, fasten it with a tack on the side of the block, and grind away, running the dynamo about half speed. With this arrangement, and a little judgment, commutators can be kept smooth and round at little expense.

The Machinery Hall at the Industrial Exhibition presented but few exhibits in the electrical line this year. The honors were divided between the Ball Co., the Toronto Electric Light Co. and the Kay Electric Works, Hamilton. The lighting of the various buildings was done jointly by the Toronto E. L. Co. and the Ball Co. Not only was Machinery Hall less interesting from an electrical standpoint than on some former occasions, but a great falling off was observed as compared with former machinery exhibits of all kinds. The management of the Exhibition must give more attention to the requirements of machinery exhibitors if the retrograde movement which has already set in in this important department is to be checked.

NOTES.

Dilute muriatic acid will take the muddy deposits out of gauge glasses.

Foaming in a boiler is most frequently caused by impurities in the water supply.

It is estimated that 20,000 horse power will be required for the electric lighting plant of the Columbian Exposition.

The *Northwestern Mechanic* says:—Vertical engines seem to be coming more and more into favor in this country for electric lighting, both for slow and high speeds. They have long been popular in England, and now quite a number of American engine builders are selling vertical high-speed compounds, and so far they appear to have been very successful.

A gentleman, well known as a maker of recording gauges, has a little son of an inquiring turn of mind. The other evening the boy said to his father: "Papa, where is Atoms?" Father—"Athens, you mean; don't you, my dear?" Inquiring son—No, Atoms, the place where people go to when the boiler explodes; because it always says they were blown to Atoms."—*Electrical Review.*

In the discussion at Providence of the topical question: "How many times per minute can a dashpot apparatus be lifted, such as used with Corliss' valve gear?" the case of an engine running at the Trenton Iron Works was cited by two or three members. It has worked successfully for several years, at 160 revolutions per minute. Another case where 150 revolutions is attained was mentioned.

That it is almost impossible for a steam engineer to secure a situation to-day unless he has sufficient knowledge to operate an electric plant, is well known, and it would seem axiomatic to state the converse proposition, and say that no electrician should be held competent to superintend a central station, or even an isolated plant, whether for railway power distribution or isolated lighting, who does not know whether or not the steam plant which drives his dynamos is being worked not only with safety to the neighborhood, but also with reasonable efficiency and economy. The weakest part of central station work has been and still is more frequently found to-day in the boiler room than elsewhere.—*Electrical Age.*

A shaft that is crooked, and is run in bearings that are in line, consumes power equal to the amount of strain it requires to bring it into line, and this strain is constant in any position that the shaft may be in, but as it revolves it shifts the strain to the bearing, and has a tendency to wear and loosen it. If the shaft is straight, and the bearings are out of line or level, the result is similar as to the constant strain of bending the shaft as it revolves, but the strain on the bearing will be one way all the time, and the tendency will be to wear the bearing in a direction that will allow the shaft to straighten itself. If a shaft is crooked and the bearings are out of line to the same amount, there will be one point in each revolution where there will be no strain, but opposite to that will be a point where it will be double, and the result will be a jerky motion, worse than if one or the other was right.

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NOTES.

An excellent way to discover the whereabouts of pound about an engine, is to place the end of a piece of rnbber hose to one ear and the other at different parts of the engine. Sometimes it may be necessary to stop up the other ear, as sound travels in a very deceptive way. Some engineers put the end of a thin pine stick between the teeth, and let the other end touch the suspected part of the engine. We have always found the hose quicker and more reliable.—*Boston Journal of Commerce.*

A pneumatic telephone has been patented in Canada by Mr. George Noreau, of Quebec, Que., on the 23rd of May, 1891, (No. 36,667.) This telephone consists of a box at each end of a speaking tube, this box contains mechanism for operating the call bells. A bulb of elastic material, when squeezed, causes the bell to ring. The speaking tube has a branch at each end that may be held to the ear, thus an uninterrupted conversation may be carried on in the same manner as the electric telephone.

Says the *Locomotive :* " It should be remarked that water may be heated above 212° Fah. without passing into steam, and while it is under ordinary atmospheric pressure, provided it is kept perfectly quiescent ; but let the slightest motion be communicated to it—even the tremor produced by a footstep—and behold ! the water which was calm and quiet suddenly flashes into steam. This is the mysterious cause of so many steam-boiler explosions, which take place when the valves have been closed for some time, and the boiler quiescent."

Perhaps readers will be interested in a kink in the engine which came to my notice recently, writes a correspondent of the *Scientific Machinist.* I have been troubled with the boxes on my crank pin getting warm and cutting away very rapidly I could not locate the cause for some time. I had put my engine in perfect line, and still the trouble kept on. I was on the point of using some strong engineer's language, when I thought perhaps the trouble was in the strap of the crank pin boxes. So I took it off and again filled up my boxes and put them back, but instead of screwing the nuts tight before driving the key in, I inserted the bolt and drove the key down hard, and then tightened up the nuts. Then, loosening up the key, I drove it to the proper place. I have not been troubled with hot boxes since. This way you put your boxes in perfect condition before you have made your strap fast.

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NOTES.

The Jenckes Machine Co., at Sherbrooke, Que., has just completed a very large colliery winding engine, 60 tons in weight, ordered by the Intercolonial Min'ng Co., for work at their mines at Westmill, Nova Scotia. The engine is a double one with cylinders 28 x 60 inches, fitted with Cornish valve gear, and is 500 horse power. The drums are ten feet in diameter, aud will wind over 5,000 feet of rope each, and it is intended to hoist seventeen boxes of coal at each lift from the slope of the mines, which are at present about 4,000 feet in depth.

Professor Wiggins, the inspired prophet of weather, has evolved a new idea from the Torricellian Vacuum in his maintop. According to this euphoniously named seer, we are to have a dry summer on account of the increased use of electric wires. The analogy is as *apropos* as if one should say, Baby McKee will take the croup because the Prince of Wales plays baccarat. The official weather prognosticator is enough for one country to be afflicted with. We can abide, with at least a simulation of patience, the mistakes of Greeley, but spare us from the Tices and the Wigginses.—*Electric Enterprise.*

It may be strange to engineers, but it is stated to be a fact, that in high pressure hot water heating the water frequently becomes red hot, pressures of 1,000 to 1,200 pounds per square inch being reached, and when the circulation of the system is defective the pipes become visibly red in the dark. One of the main obstacles in the way of using steam of very high pressures and correspondingly high temperatures, is the difficulty in properly lubricating the cylinders and keeping the stuffing boxes properly packed. With this difficulty overcome, pressures of 400 or 500 pounds to the square inch would be as common as 125 pounds to-day.

The employées on the Victoria Electric Tramway, numbering 33, recently struck for a reduction in the hours of labor from 12 to 9. The president of the company states that he can get plenty of men to fill the places of the strikers.

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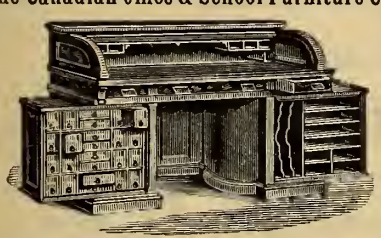
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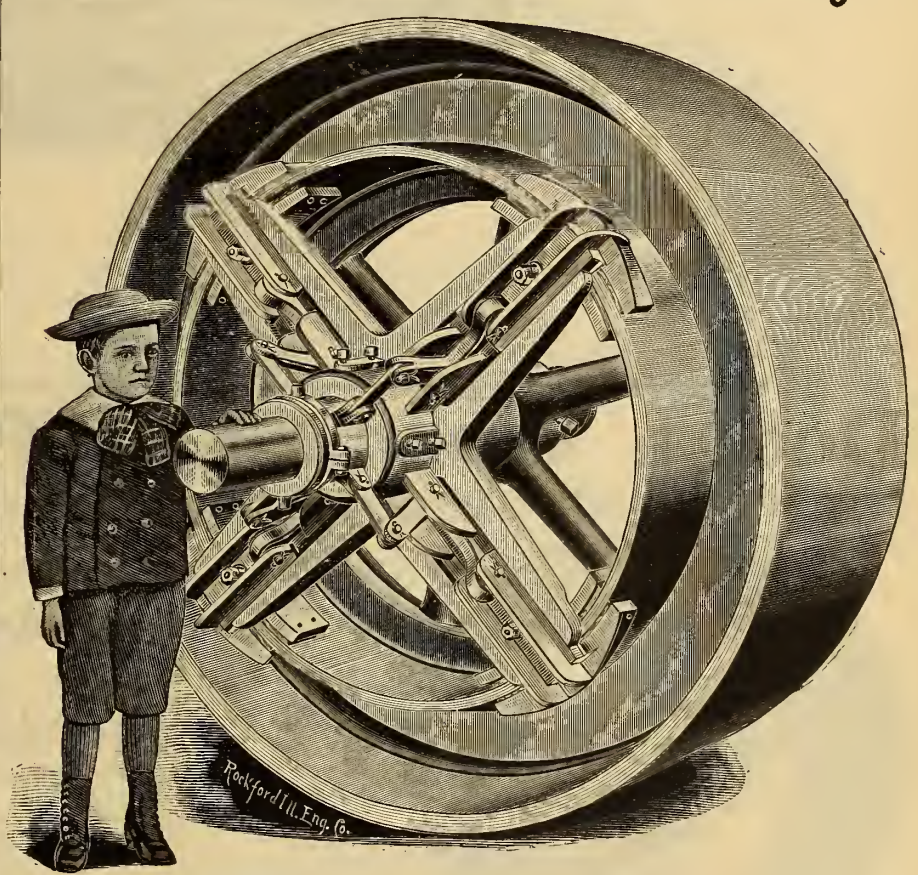


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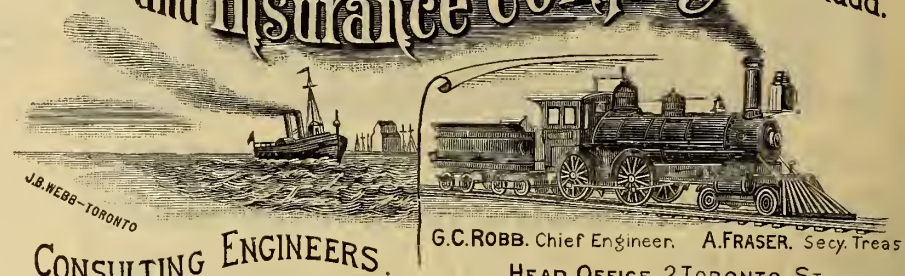
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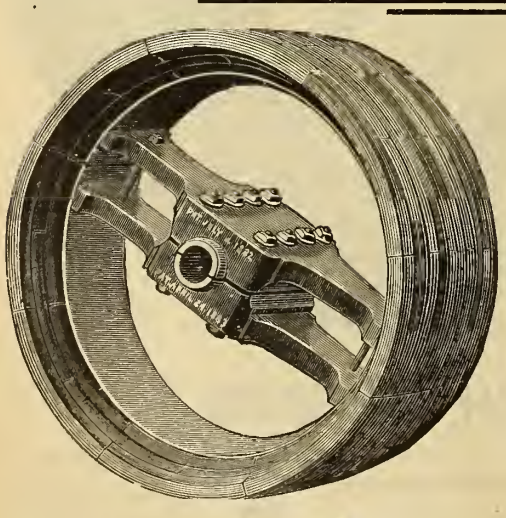
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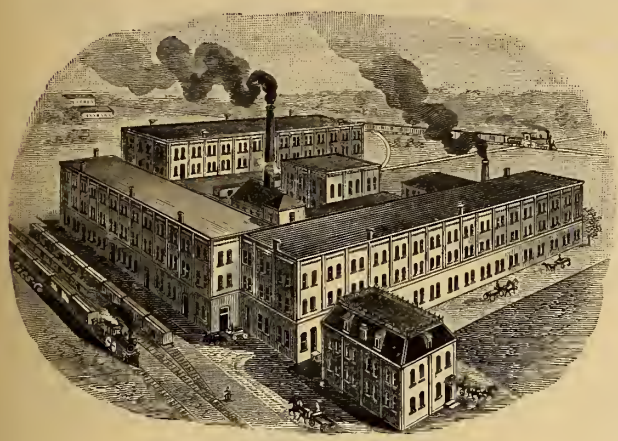
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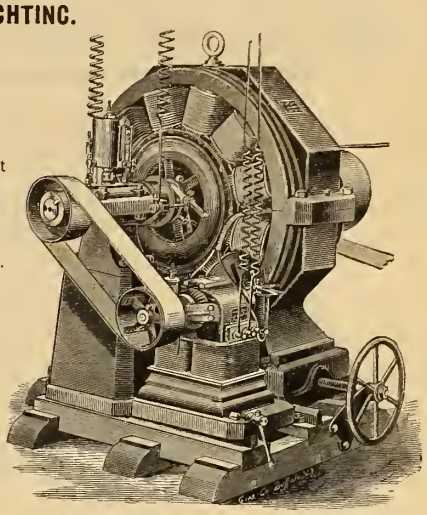
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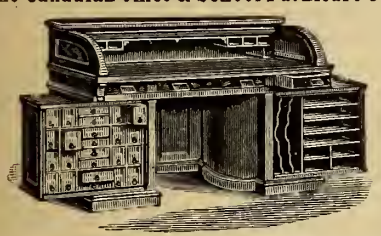
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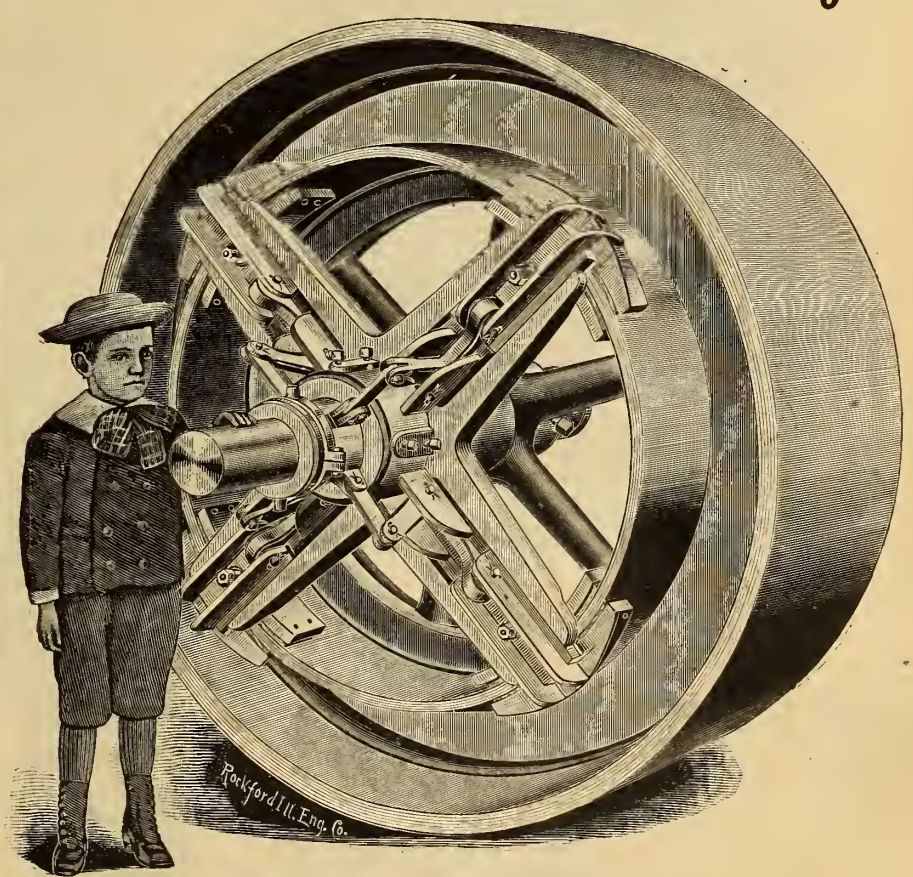
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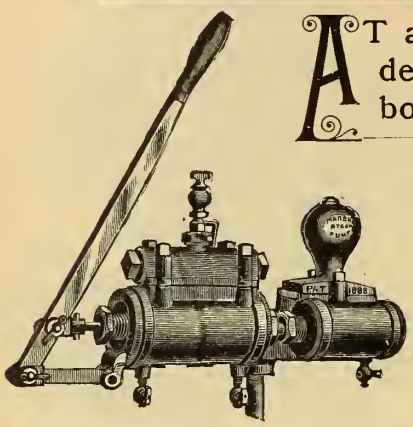
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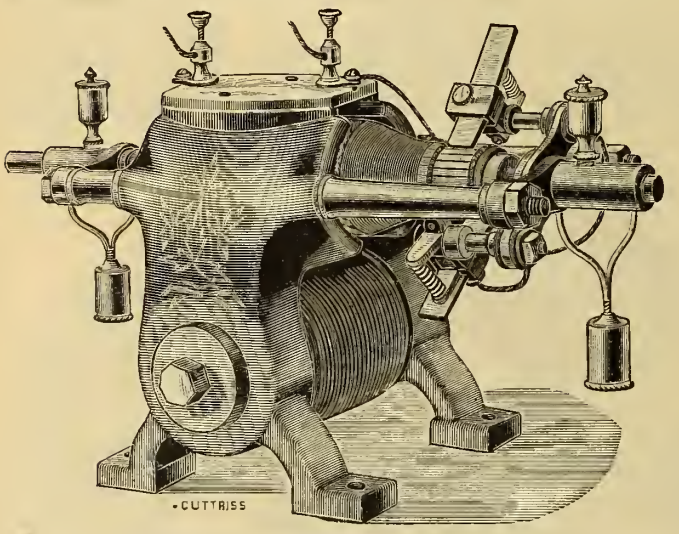
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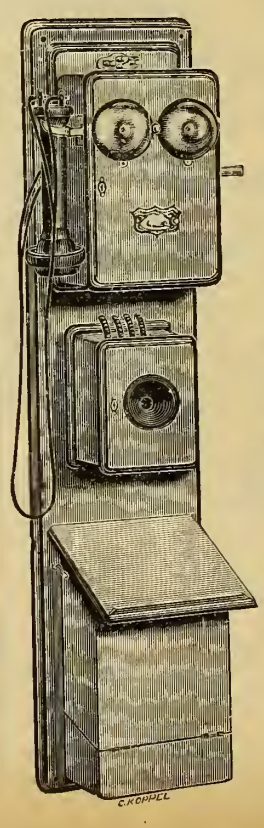
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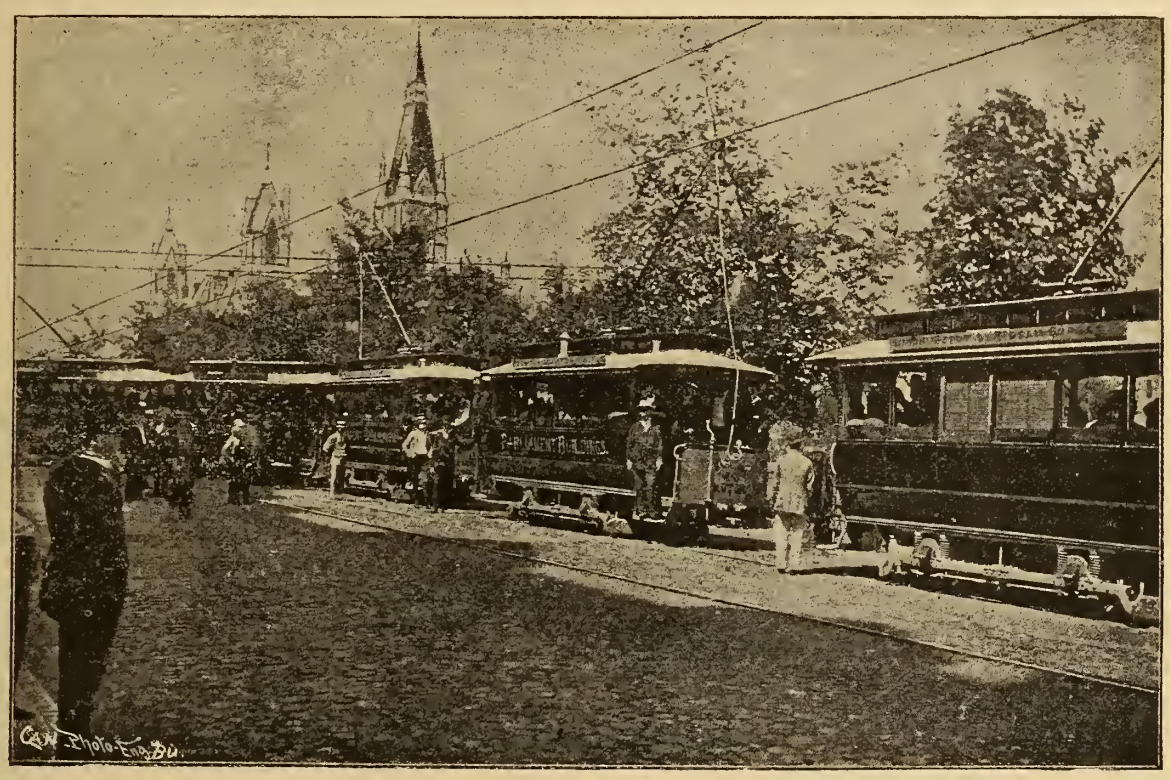
VOL. I. TORONTO AND MONTREAL, CANADA, NOVEMBER, 1891. NO. 11.

OTTAWA ELECTRIC STREET RAILWAY.

WE take pleasure in presenting to our readers an illustration accompanied by a few particulars of the electric street railway recently completed and put in operation in the capital city of the Dominion.

The total length of the road is about ten miles. The guage is 4 ft. 8½ inches. The motive power is supplied by two 100 h. p. Westinghouse generators, driven by water power obtained from the Chaudiere.

The cars, sixteen in number, manufactured by Messrs. Patterson & Corbin, of St. Catharines, are each equipped with two 20 h.p. Westinghouse single reduction motors, and are lighted by incandescent lamps. T rails are used, and the roadbed and tracks are of the most substantial character. In fact, the construction of the road in every particular is in accordance with the most modern practice. The work was done under the direction of Messrs. Ahearn and Soper, of Ottawa.



OTTAWA ELECTRIC STREET RAILWAY.

The road has worked very satisfactorily, no difficulty being experienced in mounting the steep grades on certain portions of the line.

We regret to see it stated that by a curious blunder on the part of the provincial registrar's office the route of the railway is discovered to have been incorrectly laid down, engendering doubt as to the right of the company to occupy certain streets. The officers of the company, Messrs. J. W. McRae, president; Geo. P. Brophy, vice-president; Wm. Scott, treasurer; D. C. Dewar, secretary, were obliged to fight the existing horse car company for the right of way, and the enterprise which they have displayed should entitle them to be exempt from suffering further annoyance and loss on account of mistakes on the part of other people.

TREATMENT OF STEAM BOILERS.

OUR contemporary, the *Canadian Journal of Commerce*, deserves credit for its evident desire to enlighten its readers in regard to things pertaining to machinery and to steam appliances.

In a recent article on the "Treatment of Steam Boilers," it gave some sensible advice on the necessity of keeping the safety valves free, the water gauges clear, blow-off cocks, pumps, and everything about a steam boiler in proper order. All this is very good, but when one has to define what "proper order" would mean for these steam appliances, there is room for difference of opinion. Not very many years ago, when steam boilers were comparatively new things, and the pressure used in them was not more than a few pounds above that of the atmosphere, the waggon-shaped boiler was one style that was very extensively adopted. James Watt used them, and in the early books of steam engineering, elaborate rules were given for the proper proportions of these boilers. They were constructed to safely carry a few pounds pressure, but from their shape were liable to injury from the internal pressure of the air should the cooling off of the boiler produce a vacuum inside. To guard against this, a safety valve was made, and arranged to open inwards, and admit the air, whenever the steam pressure fell.

The writer for the *Journal* seems to have lived in those days, or to have got hold of the cautions and directions for using these low pressure boilers, and now, in the days when 100 lbs. steam pressure is common, seriously warns the public against the danger of injury to a cylindrical boiler by a "vacuum" being produced inside, and gives it as one of the common causes of boiler explosions!

He does not say that the "vacuum" explodes, but that "the ring becomes indented or *swagged*," and explosion results from

this. If he had said that a "vacuum" in the "engineer's" head was a frequent cause of explosion, we would cheerfully have recommended that the Stationary Engineers' Society present him with their medal.

The putting of a new plate into an old boiler is, according to this article, another cause of boiler explosions—the reasons assigned being that the new does not agree with the old. In ancient times, when leather bottles were used, we have good authority for saying that new wine put into old bottles produced something like an explosion, but where, outside of this article, will be found any authority for the statement that the way to make a boiler explode is to put new plates in the bottom of it?

The means suggested for the prevention of explosions are almost as dangerous as those given as being the causes of explosion. It is not enough to keep a vacuum out of a boiler, and never to put a new plate in the bottom, but every boiler after it is two years old, according to this article, should once every six months be "tested with cold water." The problem is solved! Keep the cold water in ALL THE TIME, and never let it become hot, and there will never be another explosion! We give this last suggestion as our addition to the *Journal's* plan, and hope that when systematic compulsory boiler inspection becomes the law of the land, men who are not liable to a vacuum in the head will be appointed inspectors.

QUESTIONS AND ANSWERS.

JAS. OGLE, Brantford, Ont., writes: We have a fan to suck shavings from wood-working machinery, and we have experienced considerable trouble with the belts breaking, owing to their having to be kept exceptionally tight to act on the pulley without slipping, which I claim is the fault of the pulley being too small in diameter. The fan is calculated to run 1750 revolutions per minute; our line shaft runs 148 revolutions per minute, with a 40 in. pulley leading to a 15 in. pulley on counter shaft, and with a 35½ in. pulley on countershaft leading to 8¾ in. pulley on fan. A person would hardly realize the difference with the off in making steam—very nearly the difference of one boiler. I therefore consider it working to a great disadvantage. I would like to have you pass your opinion, and give us a method to overcome this difficulty.

ANSWER.—The sizes of pulleys mentioned will not give a speed of 1750 revolutions per minute to the fan, even if there be no slip whatever. With the first shaft at 148 revolutions per minute the fan would make 1601 revolutions, and not 1750. The probability is that owing to the great tension on the belt, some parts of the shafting are bent, and consequently power is wasted. Better results would be obtained by putting a leather cover on a pulley 10 inches in diameter on the fan, and driving it by a pulley 45 inches in diameter. The 15 inch pulley might also be covered by leather, as by so doing the belts could be run with very much less tension. Nothing is said about the width of belting used, and it is impossible to calculate the power used without knowing the width.

H. MARTINSON, Listowel, Ont., writes: Your answer to my question as to whether a "compound engine, one in which the steam is exhausted from one cylinder into the other, is more economical than a single engine whose cylinder is of as great capacity as the two combined," is unsatisfactory to me.

In your reply you say "it is *generally considered* that a compound engine is more economical than a single cylinder." A thing being "generally considered" does not make it so.

You say "it is possible to get a greater ratio of expansion with two cylinders than can be got with one?" How do you prove that? You say again: "The loss from internal condensation is very much less with the compound." Why should the condensation be less in two cylinders than in one? I should arrive at the opposite conclusion.

Again you say: "Using an automatic cut-off engine, an indicated diagram taken with 65 lbs. steam initial pressure, and cut-off at 20 per cent. stroke, should give a result of about 28 lbs. of water per h. p. per hour. The water consumption in a compound engine, figured from the indicated card in the same way, would give us at 20 per cent. cut-off and same initial pressure, about 15 lbs. of water per h. p. per hour." All you have proved in the above example is, that more steam went through the single engine than through the double one—in that case, everything else being equal, the single engine developed more power than the double.

I may be wrong, but in my opinion there is only so much power in steam, and it is cheaper to develop that power through a single engine than through a compound one. My objections to the compound are: the first cost is greater, they cost more to run, and more to keep in repair. If the compound engine is superior to the single engine, it ought to be easy to demonstrate its superiority.

ANSWER.—It is sometimes very difficult to get our correspondents to understand our efforts to enlighten them in regard to the points involved in the questions asked and answered. If a blind man were to write and ask why a rose was a more beautiful flower than a dandelion? all our efforts would probably fail if the man had previously made up his mind that the dandelion was superior to the rose; but it would not follow that our want of success was due to our defective taste, and not to the blindness of our correspondent. We are led thus to take comfort to ourselves by the criticism of our efforts to explain why a compound steam engine was better than a single engine. Our friend says "a thing being generally considered does not make it so." This remark strongly resembles the ancient question "How many legs will a calf have if you call the tail one?" the answer to which is, that the juvenile bovine creature has but four legs, and that calling the tail a leg will not make it one. But when the subject is not legs and tails, but *power*, and cost of making it and using it, we think that the opinion of those who have tried the matter, and have paid for their knowledge by actual experience, is entitled to some consideration. The result of the actual experience is, that when properly proportioned for the power to be developed, and for the pressure of steam to be used, the compound engine is more economical than the single cylinder engine. The following reasons have proved to be the correct explanation of this economy: 1st. The change of temperature in each cylinder between the temperature of the live steam and that of the exhaust is less in the compound engine, and consequently less condensation of the live steam takes place in its admission to the cylinder. 2nd. The steam condensed into water in the first cylinder is to a large extent re-evaporated during the exhaust, and passing as steam into the next cylinder, performs work at the lower pressure carried in that cylinder. There are other points of advantage in the working of a compound engine, but these cover the reasons why it is more economical in fuel. The machinery used in the steamboats crossing the Atlantic is the most perfect that skill can devise, and the objects aimed at are, to carry the heaviest load, at the greatest speed, with the least expense. Our friend says that in his opinion compound engines cost more to make, more to run and more to keep in repair. If he is correct, then all the owners and builders of these steamboats are acting very foolishly, as they all use compound engines. The progress during the last twenty years is remarkable, but none have proposed to return to the single cylinder engines. In 1872 the steam-pressure used was from 45 lbs. to 60 lbs. per sq. inch, and with compound engines the average consumption of coal was 2 1-10 pounds per horse power per hour. At the present time, steam of 160 lbs. per sq. inch is used, and the consumption of coal is less than 1½ pounds per horse power per hour. As some of these steamers use over 15,000 horse power, it is evident that a small fraction of a pound saved on each horse power per hour will amount to a number of tons on each voyage. Can our friend produce any examples of single cylinders doing such work as is found to be done by the compound engines on the Atlantic?

The council of an Ontario town recently sent inquiries to nearly all the cities and towns of Canada as to the yearly cost of each electric lamp in use for street lighting. The lights are paid for from 200 to 365 nights per year. The figures are: Montreal, $146; Toronto, $108.59; Hamilton, $102.10; Ottawa, $80; Halifax, $79; London, $94.05; Kingston, $65.80; St. Catharines, $77.10; Brantford, $105; St. Thomas, $102.20; Windsor, $80.30; Peterborough, $60; Stratford, $66; Bellevelle, $105; Woodstock, $56.50; Brockville, $101.50; Berlin, $60; Galt, $66; Cornwall, $17; Cobourg, $62.50; Truro, $85; Lindsay, $48; Barrie, $70; Yarmouth, N.S., $80; Ingersoll, $60; Bowmanville, $65.05; St. Marys, $39; Orangeville, $57; Paris, $58.50; Whitby, $45; Brampton, $64; Simcoe, $50; Kincardine, $52.80; Mount Forest, $75; Newmarket, $45; Wingham, $60; Palmerston, $45; Markham, $36. The figures are interesting, but are very incomplete. Many of these plants are run by water power. Data is wanting also as to the number of lights, length of lighting hours, and candle power of lamps.—*Electrical Engineer.*

THE DYNAMO.

DYNAMO and magneto-electric machines consist essentially of a coil of wire—"the armature"—rotating between the poles of a large magnet, the poles being bent round so as to approach each other and have the armature between them. This magnet may be either a permanent magnet of hard steel, or an electro-magnet consisting of wire coiled round a soft iron core, a current of electricity being made to circle round the wire coil, and thus magnetizing the iron core while it lasts. A magnet produces an influence in the neighborhood around it, and this surrounding neighborhood is known as the "field of force" of the magnet; *i.e.*, the sphere in which its influence can be felt.

A magnetic needle or a bit of iron filing placed in this field sets itself to point along the "lines of force" of this field; that is, the lines along which the magnetic force acts, and which form curves around the magnet, running out, as it where, from pole to pole, curving from one to the other. When a coil of wire, or armature, is made to revolve rapidly in the strong field of force which occupies the space between the poles of a powerful electro-magnet, currents are produced in the coil. These currents alter their direction through the coil every time the latter changes its position with reference to the poles of the magnet. The side of the coil which was opposite the north pole is, after half a revolution, opposite the south pole, and the influence of the south pole tends to produce an opposite current to that of the north pole. Here we have an "alternative current" dynamo machine. As the coil, or armature, rotates with great speed some hundreds of revolutions per minute—these currents in alternating directions, succeed each other very rapidly, and if an electric arc lamp is placed on the circuit it will be lit up. In this case it is not necessary that the current be sent around the circuit in one direction only; but although the terminals of the lamp are constantly changing their polarity—that is, the north pole, where the current enters, the next instant becomes the south pole, where the current leaves—yet, as this occurs many times in one second, the effect produced is the same as if the current was in one uniform direction.

In a "continuous current" dynamo, which is necessary for some purposes, such as electro-plating, where the effect desired could not be produced if the direction of the current was continually altering, the electric current is made to pass always one way round the external circuit. This result is got by using the ingenious device of a commutator, which automatically deflects the current so as always to send it in an unvarying direction. This commutator consists simply of a split tube, which is attached to the revolving armature, and may be seen in any dynamo working on the continuous system. This tube revolves with the revolving armature, and it is divided by an insulating substance into two parts. Each half is alternately on the left and right of the space between the poles of the magnet and the "brushes" which collect the current from the armature; *i.e.*, the bundles of copper wire spread out like a brush, which form each end of the outer circuit, are fixed in position, and the revolving commutator attached to the armature brings alternately one of its half-tubes into contact with a brush. Thus the half of the commutator which receives the current changes at the same time the direction of the current through the coils of the armature is reversed; in this way the current sent out to the brush which receives the electric current from the armature is always in the same direction.—Boston *Journal of Commerce.*

DRAFT.

DRAFT, so-called, is the difference in weight between two columns of air, one hot and the other cold. The former rises by reason of its lightness, and the latter rushes in to supply its place. Hot air is lighter than common air, because, being expanded by heat, it occupies more space for the same volume. Suppose, says the *Engineer*, we have a smoke stack of certain dimensions; it contains a certain number of cubic feet of air. If we build a fire at the bottom of it, we expand that air and it increases in volume, raising as it increases. Naturally this makes a column of a given number of cubic feet which is lighter than the column of the same capacity outside of the stack, and this cold air seeks to restore the balance. This is natural draft pure and simple, and as it depends upon a very slight difference in weights only, very little is needed to check it. Carrying the smoke stack or flue horizontally is a tax upon the draft proper, for the horizontal column has to be dragged by the vertical column. The horizontal column cannot rise; naturally, therefore, it has no value for increasing the velocity of the outside column of air, but has to be moved by it. All chimneys should be perfectly smooth inside, without projections of any kind; least of all should they be fouled with soot; this last is one of the greatest of obstructions. Forced or induced draft is simply compressed air driven into a furnace by means of fans, and has an artificial velocity imparted to it by them.

THE WORLD'S FAIR POWER PLANT.

As might naturally be expected, there will be required a very large power plant to drive the machinery at the World's Fair. But few, however, realize how much power it will require. Compared with the power plants of former expositions this will be tremendous. It took a 2,456 horse power engine to drive the machinery at the Centennial Exhibition in Philadelphia. At the Paris fair 6,000 horse power was sufficient. The World's Fair at Chicago will require six times as much, or 24-000 horse power, according to present estimates. The following interesting facts in this connection are furnished by the Construction Department:

In the Machinery Hall the machines on exhibition will be driven by six lines of shafting carrying the required pulleys, each line running lengthwise with the building, or about 800 feet. Each of these six lines will be driven into four sections of a length of 200 feet, and each section will be driven by an engine. This necessitates the use for power in Machinery Hall of 24 engines with a capacity of 125 to 200 horse power. These sections of shafting will be provided with friction couplings on on their ends, so that in case of accident or the disabling of any engine its section may be driven by the engine on the other side of it. Lengthwise in the Machinery Hall will travel three electric cranes of 20 tons capacity, each having a maximum speed of 400 feet per minute. During the installation of and the removal of these exhibits, these cranes will be used for transporting goods, but during the exposition they will be used to carry passengers through the halls.

At the east end of the Machinery Hall will be located the exhibit of pumping and hydraulic machines in operation. These pumps will supply water for all the grand fountains on the grounds, and for other purposes. Here will be a pumping plant almost equal in capacity to any of the plants of the water works of Chicago. There will be pumps working with a capacity of 40,000,000 gallons per day.

In the Machinery Annex will be located the electric energy plant, where a number of engines of various types will furnish the 16,000 horse power necessary to operate the generators for electricity for light and power. These engines will be located so as to form a compact central station. This plant is elastic in its proposed capacity, and its power can be extended indefinitely. The estimated necessary 16,000 horse power will probably be increased rather than diminished. In the building near the annex will be located the steam plant for furnishing steam power for this electric station.

South of Machinery Hall and opposite the centre of the building will be located the boiler house supplying the steam used in the building. This plant will be a model, and will have a capacity of 8,000 horse power. Only in Machinery Hall will steam power be used. Electric power will be used in all of the other buildings, and will be transmitted by wires from the central electric plant. It is estimated that in Machinery Hall and its annex there will be about 3½ miles of shafting.

It is not yet determined whether crude petroleum or coal will be used for fuel. To run this big plant during the exposition will require at least 75,000 tons of coal or 225,000 barrels of crude petroleum. It will require at least 250 engineers, firemen and attendants to man this plant. To keep it bright and clean during exposition will require 90,000 pounds of waste, and it is estimated that $6,060 worth of lubricating oil will be poured on its innumerable bearings.

In all heating systems designed to use exhaust steam, says the Boston *Journal of Commerce*, care should be taken to have the pipes large enough to allow the passage of the steam with the least back pressure. It is a poorly designed system that requires a back pressure of five pounds.

SAFETY VALVES—THEIR HISTORY, ANTECEDENTS, INVENTION AND CALCULATION.

By William Barnet le Van.

(Continued from October number.)

Having given the inside diameter D, and the required effective area Æ, the lift or height h to which the valve must be lifted, is as follows:

$$h_1\ n\ \mathrm{D}\cos.\ v = Æ - \tfrac{1}{2}\ h \sin.\ 2v\ n\ h \cos.\ v$$

$$h\ n\ \mathrm{D}\cos.\ v = Æ - h_2\ \tfrac{1}{2} \sin.\ 2v\ n\ h \cos.\ v$$

$$h_2\ \tfrac{1}{2} \sin.\ 2v\ n \cos.\ v + h\ n\ \mathrm{D}\cos.\ v = Æ$$

$$h_2 + h\left\{\frac{2\ n\ \mathrm{D}\cos.\ v}{\sin.\ 2v\ n \cos.\ v}\right\} = \frac{Æ}{\sin.\ 2v\ n \cos.\ v}$$

Half the square of the coefficient for h is

$$\left\{\frac{\mathrm{D}}{\sin.\ 2v}\right\}$$

Add this on both sides of the = signs.

$$h_2 + h\left\{\frac{2\ \mathrm{D}}{\sin.\ 2v}\right\} + \left\{\frac{\mathrm{D}}{\sin.\ 2v}\right\}^2 = \frac{2\ Æ}{\sin.\ 2v\ n \cos.\ v} + \left\{\frac{\mathrm{D}}{\sin.\ 2v}\right\}^2$$

The square root of this formula will be

$$h + \frac{\mathrm{D}}{\sin.\ 2v} = \sqrt{\frac{2\ Æ}{\sin.\ 2v\ n \cos.\ v} + \left\{\frac{\mathrm{D}}{\sin.\ 2v}\right\}^2}$$

Then

$$\text{Height } h = \sqrt{\frac{2\ Æ}{\sin.\ 2v\ n \cos.\ v} + \left\{\frac{\mathrm{D}}{\sin.2\ v}\right\}^2} - \frac{\mathrm{D}}{\sin.\ 2v} \quad \ldots\ldots\ldots 22$$

Example 20.—A safety valve has a diameter D=2 inches, and the valve sit has a bevel or angle v=25 degrees. What is the effective area Æ, if the annular opening for a lift h=¼ or 0.25 of an inch?

Formula 16: $Æ = n\ h \cos.\ v\ (\mathrm{D} + \tfrac{1}{2}\ h \sin.\ 2\ v)$

Effective area $Æ = 3.1416 \times 0.25 \times 0.906 \left\{2 + \frac{0.25}{2}\right\} \times 0.766 = 1.493$ square inches.

The diameter D, in example 18, can be found by using the other dimension by

Formula 21: $$\mathrm{D} = \frac{Æ}{n\ h \cos.\ v} - \tfrac{1}{2}\ h \sin.\ 2\ v$$

$$\text{Diameter } \mathrm{D} = \frac{1.493}{3.1416 \times 0.25 \times 0.906} = 2\ 15 - \frac{0.25}{2} \times 0.766 \times 909 = 2.054 \text{ inches.}$$

And the lift h as follows

Formula 22: $$h = \sqrt{\frac{2\ Æ}{\sin.\ 2v\ n \cos.\ v} + \left\{\frac{\mathrm{D}}{\sin.\ 2v}\right\}^2} + \frac{\mathrm{D}}{\sin.\ 2v}$$

$$\text{Lift } h = \sqrt{\frac{2.986}{0.766 \times 3.1416 \times 0.906} + \left\{\frac{2}{0.766}\right\}^2} - \frac{2}{0\ 766} = 0.2503$$

or as follows:

The sine of $2\ v = 25^\circ \times 2 = 50^\circ$ = ...	0.766
Multiplied by n = ...	3.1416
	2.4064656
Multiplied by cosine $v = 25^\circ$ = ...	0.906
First product.	2.1802578336
Divide $2\ Æ = 1.493 \times 2$ = 2.986 ——— =	1.36956
By the first product..... 2.1802578336	
Then divide diameter D= 2 ——— =	2.611
By the sine $2\ v = 25^\circ \times 2^\circ = 50^\circ$ = 0.766	
Square this quotient 2.611×2.611 = ...	6.8172
To this add the first quotient.....	1.36956
	8.18676
The square root of this sum $\sqrt{8.18676} = 2.8613$	
Now divide diameter D=2 ——— = 2.611	
By the sine $2\ v = 25^\circ \times 2 = 50^\circ = 0.766$ ———	
Subtract this latter quotient from the root of the above, and the remainder will be the lift h = ...	0.2503 inches.

TO FIND THE ANGLE OF A VALVE SIT.

From the largest diameter subtract the smallest diameter, and divide half this difference by the depth of bevel of the valve sit, and the quotient is the tangent of the angle v.

The algebraic expression is as follows:

Let D=largest diameter of valve sit in inches.

d=smallest diameter of valve sit in inches.

k=depth of valve sit in inches.

v=angle, or bevel.

$$\text{Tangent } v = \frac{\mathrm{D} - d}{2\ k} \quad \ldots\ldots\ldots 23$$

Example 16.—The largest and smallest diameters of a valve sit are D=3½ and d=2½ inches respectively, and the depth k=½ or 0.5 inch. What will be the angle of the valve sit?

Formula 23: Tangent $v = \frac{3.5 - 2.5}{0.5 \times 2} = 1$, the tangent of the angle of the valve sit.

Or, largest diameter D=3.5

Smallest diameter d=2.5

1.0

$0.5 \times 2 = 1.0$

Tangent v=1

The angle corresponding to this tangent by table is 45 degrees.

SAFETY VALVE AREAS.

The writer, in 1867, had the honor of being appointed by the president, one of a committee of four members of the Franklin Institute, to which was referred the consideration of the legal requirements which should be made for safety valves and pressure gauges upon steam boilers erected in the city of Philadelphia, in accordance with acts of the Assembly of the State of Pennsylvania, approved May 7th, 1864. The following report was approved by ordinance of councils of the city of Philadelphia, July 13th, 1868:

The committee did not in American or English practice of engineers or boiler-makers find any general rule of dimensions of safety valves, that had been acknowledged, relating to other dimensions of boilers, or to the pressure of steam or to the rates of combustion of fuel, although such relationship is admitted by the assumption and practice of different constructors without any definite rule.

Neither have those writers in our language, whose works are regarded as authoritive upon the subject of steam and the steam engine, nor has American or English legislation, established or stated suitable proportions and requirements for the various conditions. On the other hand, the laws of France, Prussia, and other continental nations, have been framed with an evident appreciation of the essential demands, and established areas of valve openings for all sizes of, and pressures of steam in, boilers, so that it had only remained for the committee to translate into English measures, to modify the ratios by using, as the surface of comparison with the safety valve area, the grate surface in place of that adopted by the French—boiler surface, and to make a further correction by embracing in the rule the differing rates of combustion upon the grate surface.

The committee have not found, nor have they sought very carefully, the reasoning upon which the French rule, or formula, has been based, and will say that they reached the same conclusion independently, and were not a little surprised by the coincidence after their own investigation.

We proceed to give, as briefly as possible, those considerations which control or influence this question of area of safety valves:

A safety valve is a loaded valve covering an orifice opening outwards from a boiler, which valve is intended to lift whenever the pressure of steam within the boiler rises above that to which the valve has been loaded; and the opening thus produced ought to discharge the steam of the boiler in such quantities that the pressure within shall not exceed, to any considerable degree, or beyond some fixed limit, the defined pressure at which the valve opened.

Upon this proposition, it is evident that a safety valve may sometimes be required to discharge all the steam which, under the most favorable conditions, may be formed by evaporation in any given time. As the rapidity of the evaporation of water is evidently the result of rapidity of combustion of fuel, which itself refers to extent of grate surface and strength of draught or blast (supply of air), we take the grate surface, or area, as that element of a steam boiler presenting the most readily-measured surface for comparison with the required area of the opening or least section of the aperture or channel of discharge of an opened safety valve. We can assume that the draught or supply of air to the fuel being burned under any given steam boiler, is, on the average, that existing in ordinary stationary steam boilers with chimney draught, and afterwards correct our proportions for forced draught or blast, and more active combustion. In like manner, we can modify the results, based on this assumption, to suit the conditions of boilers which are heated by the waste heat or by the burning of gases unconsumed in manufacturing processes. As it is the object of investigation to determine that area of safety valve needed to insure safety, it is proper to give so great an excess above the absolute demand for the sectional area of the vein of steam escaping from a boiler under any given pressure as will be sure to cover the emergency of extraordinary rapidity of combustion during any short period of time, and also to include the coefficient of resistance to discharge through a passage offering as much resistance as the one formed by lifting a disk valve of the ordinary construction from a flat seat.

We here notice that there may be so large an excess of area that the opening of the valve may, by its sudden relief of pressure and discharge of steam, especially in boilers with limited water surface for the elimination of the steam from the water, dangerously disturb the equilibrium of circulation of water within the boiler; and also that the safety valve may be so badly formed, in regard to shape of disk and seat, that after lifting a little without any change of load upon the valve, the pressure within the boiler may dangerously increase, while a small quantity of steam only is discharged. In both of these points of difficulty we will refer to the practice of engineers, only saying here that the ratio of excess which we assume, when applied to the case of the gradual rising of temperature and pressure which occurs in a boiler containing a mass of water, and only admitting the gradual opening of the valve, is much below any dangerous condition, and our assumed excess is really additional safety. The assumption of considerable excess also allows us, when in our theoretical examination we find considerations of obviously very small value, to reach, in a practical form, a perfectly satisfactory general result. Proceeding on these grounds, therefore, let us take the average combustion of a well-set or arranged boiler at 8 pounds of coal (or fuel equivalent) per square foot of grate per hour, and that the maximum combustion, when the fire is in the best condition, and is evolving heat most

rapidly can be taken at three times that of the average. That is, for a portion of time we must assume that the rate of burning will be 24 pounds of coal per square foot of grate per hour. We can estimate with the slow rate of average combustion assumed, and with adequate heating surface to the boiler, which surface shall be in good working order, both within and without, that there will be evaporated 9 pounds of water to each pound of coal consumed. This gives a maximum rate of evaporation of 216 pounds of water per square foot of grate per hour, or 0.06 pound of wa er per square foot of grate per second.

On the grounds stated in a preceding paragraph, we may neglect the increase of heat demanded for the evaporation of water at higher temperatures than 212 degrees, and assume, within our limits of 20 to 120 pounds above the atmosphere, the weight of water evaporated or quantity of steam produced by the combustion of a given quantity of fuel to be constant.

Whatever error there is, from taking a larger quantity of steam at the higher pressures than is actually produced by the result, only adds to the dimensions of the safety valve of such higher pressures, and is an error in a safe direction, as well as a very small one.

When we come to the discussion of how great an allowance of excess of size over absolute requirement is to be made, we take first the coefficient of friction, as found by experiment on the flow of liquids through apertures and passages of a character similar to the passage of a safety valve $Æ = 1.5\ a$ where $Æ$ is the area of absolute requirement sought, and a the sectional area of the vein or tube of fluid, supposing no resistance from the mouth of discharge to exist. And secondly, the practical coefficient employed to give adequate excess of area of valve for all contingencies. This last has been taken at eight times the area of absolute requirement; or $A = 8\ Æ = 12\ a$, where A is the area of the valve sought, and a, as before, the values of $Æ$, A and a, being taken in square inches.

The most simple equation expressing the relation of volumes of steam to water, applicable to our purpose, is that given as the result of experiment by Fairbairn and Tate:

$$W\,p = \frac{389}{p + 15.052} + 0.41$$

Where $W\,p$ = the volume of one pound of steam in cubic feet, under any nominal pressure p per square inch above the atmosphere. Whence we have:

$$W = 0.06\left\{\frac{389}{p + 15.052} + 0.41\right\} = \text{cubic feet of steam formed, under our supposition, per second.}$$

The height of column to effect the discharge of steam under any pressure p (per square inch), is evidently equal to the volume of p pounds of steam multiplied by 144.

$$h = 144\ p\left\{\frac{389}{p + 15.052} + 0.41\right\}$$

and the theoretical velocity of discharge in feet per second $= v = 8.025\ \sqrt{h}$.

$$v = 8.025\ \sqrt{144\ p\left\{\frac{389}{p + 15.052} + 0.41\right\}}$$

The size of the vein a (in square feet), which will convey the volume W at the velocity v per second, is:

$$a_1 = \frac{W}{v} = \frac{0.06}{12 \times 8.025} \cdot \frac{\frac{389}{p + 15.052} + 0.41}{\sqrt{\frac{389}{p + 15.052} + 0.41}}$$

but $144\ a_1 = a$, and $12\ a = A$. $\therefore A = 1728\ a_1$

$$\therefore A = \frac{1728}{12} \times \frac{0.06}{8.025} \cdot \frac{\left\{\frac{389}{p + 15.052} + 0.41\right\}^2}{\sqrt{p\left\{\frac{389}{p + 15.052} + 0.41\right\}}}$$

Taking the above facts into consideration, the committee arrived at the following formula:

$$A = 2r.23\ \sqrt{\frac{1}{A}\left\{\frac{1}{p + 15.052} + 0.00195\right\}} \quad \ldots\ldots\ldots\ldots\ 24$$

We will now compare this with the legal formula of France, which reads:

$$A\ (\text{in centimeters}) = 0.00053\ \frac{s\ (\text{in meters})}{n - 0.412}$$

where

A = area of safety valve.

s = heating surface of boiler in square meters.

n = absolute pressure of steam in atmospheres.

We can safely take the French practice in construction of their boilers at 20 units of boiler surface to each unit of grate surface, as the boilers in general use in France assimilate in these ratios to those of our long cylinder or two-flued forms, when the proportions generally correspond. Substituting this value, and taking 14.7 pounds for the atmospheric pressure, deducting one atmosphere of constant pressure, and reducing the whole to American weights and measures, we have:

$$A = \frac{22.5\ G}{p + 8.62} \quad \ldots\ldots\ldots\ldots\ 25$$

where

A = area in square inches of safety valve per square foot of grate surface.

(To be Continued.)

MONTREAL BRANCH NO. 1, C. A. S. E.

Editor ELECTRICAL NEWS.

DEAR SIR,—The annual meeting of Montreal No. 1, C.A.S.E., was held in Mechanics' Hall, on Thursday evening, Oct., 1st, when the following officers were elected for the ensuing year:—

Thomas Nadin, President; Edmund Hay, Vice-President; Henry Nuttall, 2nd Vice-President; J. G. Robertson, Recording-Secretary; J. E. Huntington, Financial-Secretary; Thomas Ryan, Treasurer; Henry Rollins, Conductor; A. Nuttall, Door Keeper; Jas. Dooner, Hugh Tipping and Geo. Redpath, Trustees.

Yours truly,

JOS. G. ROBERTSON,
Secretary.

PISTON SPEED NEEDED.

THE table here given shows the piston speed in feet per minute required to produce one gross horse power, with various mean effective pressures per square inch, and with various piston diameters and areas.

For other horse powers the speeds needed will be exactly proportionate; that is, 100 gross horse power will require 100 times the speed needed for one. With other mean effective pressures, and with other areas, the speeds required will be inversely proportionate; that is, 11½ pounds mean effective pressure per square inch will take double the speed needed with 32½; 100 square inches will take double the speed needed with two hundred.

PISTON SPEED NEEDED TO PRODUCE ONE GROSS HORSE POWER.

PISTON. Diam. In.	PISTON. Area Sq. In.	MEAN EFFECTIVE PRESSURES, POUNDS PER SQUARE INCH. 10	12½	15	17½	20	22½	25	27½	30
4	12.57	262.5 ft.	210. ft.	175. ft.	150. ft.	131.3 ft.	116.6 ft.	105. ft.	95.5 ft.	87.5 ft.
6	28.27	116.7	93.4	77.8	66.7	88.4	51.9	46.7	42.4	38.9
8	50.26	65.7	52.5	43.8	37.5	32.8	29.2	26.3	23.9	21.9
10	78.54	42.	33.6	28.	24.	21.	18.7	16.8	15.3	14.
12	113.09	29.2	23.3	19.5	16.7	14.6	13.	11.7	10.6	7.7
14	153.93	21.4	17.2	14.3	12.3	10.8	9.54	8.58	7.8	7.15
16	201.06	16.4	13.1	10.9	9.38	8.2	7.29	6.56	5.97	5.47
18	254.46	13.	10.4	8.65	7.41	6.48	5.76	5.19	4.72	4.32
20	314.16	10.5	8.4	7.	6.	5.25	4.67	4.2	3.82	3.5
24	452.38	7.3	5.84	4.86	4.17	3.65	3.24	2.92	2.65	2.42
30	706.85	4.67	3.74	3.11	2.67	2.33	2.75	1.87	1.69	1.56
36	1017.87	3.24	2.59	2.16	1.85	1.62	1.44	1.3	1.17	1.08
42	1385.44	2.38	1.87	1.56	1.33	1.17	1.04	.933	.848	.794
48	1809.55	1.82	1.46	1.22	1.04	.912	.811	.73	.663	.608
60	2827.43	1.17	1.33	.778	.667	.584	.519	.467	.424	.389
72	4071.5	.811	.649	.541	.463	.406	.36	.324	.295	.27

—Power and Transmission.

PERSONAL.

Mr. John Carroll, manager of the Eugene Phillips Electrical Works, Montreal, spent a couple of days in Toronto, recently. He is a friend to the movement for the formation of a Canadian Electrical Association.

PUBLICATIONS.

Mr. H. W. Petrie, of Toronto, has sent us a copy of a new catalogue (No. 16) of new and second-hand machinery, just issued.

It is rumored that the executive department of the Edison General Electric Co. will undergo reorganization at the annual meeting in January next.

NOTES.

Diluted muriatic acid will take the muddy deposits out of guage glasses.

Steam hammers are now being made with compound pistons, with a view to the utilization of waste of steam.

Mr. Robert Macfarlane, of Magog, Quebec, was recently granted a patent on a tubular water grate for steam boiler furnaces.

The Robb Engineering Co., capital $249,000, has succeeded to the business of Messrs. A. Robb & Sons. at Amherst, Nova Scotia.

The Thermolytic Fuel Company, of Canada, has been organized at Napanee, Ont., with a capital stock of $12,000, to acquire certain patents relating to improvements in steam boiler furnaces, and to manufacture the same.

By the explosion of a boiler in Spencer's saw mill at Walsingham Centre, Ont., recently, Clark Brunson, fireman, was thrown a distance of 100 feet, and so scalded and mangled that he lived but a few minutes after the event.

A certain amount of air admitted to the furnace above the live coal is advantageous rather than otherwise, if the supply be regulated. The oxygen of the air thus introduced assists in the more effective combustion of the gases.—*Practical Mechanic.*

The Northey Manufacturing Co., Ltd., has been organized with a capital stock of $100,000, to succeed the firm of Northey & Co., Toronto. The new company will manufacture and deal in steam pumps, engines, boilers, machinery, iron and other metals, etc.

According to Prof. Rogers, of Washington, a single pound of good steam coal has within it dynamic power equivalent to the work of one man for one day. Three tons of the same coal represent a man's labor for a period of twenty years, and one square mile of a seam of coal having a depth of four feet only, represents as much work as one million men can perform in twenty years.

In connection with the equipment, for fire protection, of wood-working establishments, it is recommended that a gallon pail, filled with fine sand, be always placed within convenient reach of each workman employed where oiling and finishing is being done. This practice might well be followed wherever there is a possibility of fire starting in oils or oil-soaked materials. There is nothing which will squelch an oil-fed fire in its incipiency more quickly and effectually than sand—and there are no afterclaps in the way of water damage, either.

Experiments made twenty years ago on the non-conducting properties of boiler scale, gave astonishing results. The effect of the scale accumulation is given as follows: 1-16 inch thick requires 15 per cent. more fuel; ¼ inch 60 per cent. more fuel, and ½ inch thick 150 per cent. more. To produce steam at 90 pounds pressure, in a clean boiler, only 355 degrees of heat are required, but with heavy scale this temperature must be increased 200 to 300 degrees. For ½ inch of scale the heat must be 700 degrees, or almost a low red heat for the iron. Professor V. B. Lewis, F.C.S., I.C., after discussing the nature of boiler deposits in a recent lecture, recommended the following means of preventing these dangerous accumulations: 1. Filtration of condenser water through a coke column. 2. Free use of the scum cocks. 3. The use of water of considerable density rather than of fresh water. 4. The use of pure mineral oil lubricants in the smallest possible quantity.

Some time ago, says *Industries*, we directed the attention of our readers to a proposal by Prof. Thurston for reducing the internal wastes of steam engines by reducing the heat-conductivity and the heat-storing power of the internal surfaces of steam engine cylinders. The same thing had been attempted many times before, but without very much success. Prof. Thurston believed that he had discovered that it would be possible to form upon these surfaces a non-conducting stratum, integral with the material of which they were composed, with the metal of the cylinder itself, that should intercept the heat tending to pass away without transformation in any appreciable degree into work. This he had proposed to bring about, first, in any convenient and inexpensive way, effecting a partial solution of the superficial portion of the metal, leaving a spongy layer; then by the impregnation of this sponge with a resin or other non-conducting material produced by the painting of this surface with drying oil or with any available substance that should thus be found able to permeate and cling to the porous surface. Prof. Thurston's proposals were based only on laboratory experiments, but since they were made they have been tested on a larger scale, and he now thinks the matter fully settled.

For softening water by means of hydrated oxide of lead cheaply, says the *American Machinist*, it is necessary to obtain the oxide, and the following method has been devised by M. Villon. A solution of sodium nitrate is placed in a vat, divided into two compartments by a diaphragm; lead electrodes of large surface are placed in the solution and the current from a dynamo then passed through. The sodium nitrate is decomposed, caustic soda being formed in the negative compartment, and nitric acid at the positive pole, from which it dissolves a certain quantity of lead, forming lead nitrate When the current has passed through the liquid for a certain time, the solutions are run from the two compartments into a second vat, and there mixed by means of an agitator. The soda precipitates hydrated oxide of lead and itself forms sodium nitrate; the solution is then filtered, and the nitrate solution again submitted to electrolysis. When the baryta or lead oxide are used up, they are replaced by freshly prepared oxides. The purification by barytes is more perfect than that by lead oxide. According to M. Villon, the use of the filter press can be avoided by employing plumbate of sodium—a solution of lead oxide in caustic soda. The precipitate is simply allowed to settle out, and the water obtained shows a hardness of about two or three degrees.

An English naval engineer has invented a simple and ingenious system for adding to the effectiveness and life of steam boilers by doing away with the severe strain which follows the first starting of the furnaces. The remedy consists of an arrangement whereby the present furnace fronts are substituted by steel heating chambers of the same length as the boiler. These chambers, which do not in any way interfere with the grate furnace, are, at starting, filled with water from the bottom of the boiler, or from any other point in the boiler where there is no circulation. A small fire is lighted in the furnace at first, which heats up the water in the chambers, and by degrees the remainder of the water in the boiler becomes heated. and the shell is also gradually warmed, a uniform temperature being obtained. As soon as the temperature has become uniform the fires are made up and steam is raised to the working pressure. The primary work of the heaters having been accomplished they are now used as feed water. The feed water instead of going into the boilers direct is diverged into the heaters and is brought to a temperature of 220 degrees Fahrenheit. It will thus be seen that the arrangement is that of a combined automatic circulator and feed water heater, which not only does not rob the boiler of steam, but arrests and utilizes heat which would otherwise be wasted. The saving of fuel gained by this invention is said to be 7 per cent.—*Railway Register.*

TRADE NOTES.

The Ball Co. report a brisk demand for their newly-designed small automatic incandescent dynamos for factory and warehouse lighting, a full line of sizes from 25 to 150 lights being carried in stock.

At the late Montreal Exhibition a very fine show of dynamo belting was made by Messrs. Robin & Sadler in the machinery hall. A 22 inch and an 18 inch made for the Royal Electric Co. were among the largest of these belts, and were a credit to the manufacturers. Some large belting made for W. W. Ogilvie's Glenora Mills and for the Montmorency Cotton Co., was also on exhibit, together with numerous other rolls of different sizes and belt leather, lace leather, &c.

The Ball Electric Light Co. have recently installed apparatus as follows: Automatic Ball dynamo for incandescent lighting in Coulter & Campbell's copper works, Toronto; a 450 light Wenstrom automatic incandescent dynamo for Z. Paquet, Quebec; 50 arc light street lighting plant for corporation of Toronto Junction, completed and awaiting the fitting up of engine house; a 2 h. p. Ball 250 volt motor for Roberts Storage Battery Co., for driving machinery.

A USEFUL FORMULA.

THE following is a simple formula for determining the insulation resistance between a dynamo circuit and its frame:—

$$R = \frac{E - \mathcal{E}}{\mathcal{E}} \times r,$$

where R = insulation resistance in ohms, E = the terminal e.m.f. of the machine, $\mathcal{E}$ = the sum of the volts observed between the positive brush and the frame, and r = the resistance of the voltmeter, which must be very high.

STEAM VS. WATER POWER.

CHARLES E. Emery, Ph. D., in the *Crank*, gives the following comparative estimate of the cost of steam and of water power for a cotton mill of 25,000 spindles, requiring, say 400 horse power:

STEAM.

Interest on cost of plant, 6 per cent. on $35,680	$ 2,141		Per year.
Sinking fund for renewal	892		"
Operating expenses	3,195		"
Fuel	7,208		"
Total	$13,436		"
Per horse power		$33.59	"

WATER.

Interest on cost of plant, 6 per cent., on $35,680	$ 2,141		Per year.
Depreciation and repairs, 2½ per cent.	893		"
Water tender	618		"
Interest on the cost of the steam plant necessary to supply steam for heating mill, use of slashers, &c., 6 per cent on $5,796	348		"
Repairs and renewals of same	318		"
Fuel	1,900		"
Labor	618		"
Total	$6,836		"
Per horse power		$17.09	"
Difference per horse power between steam and water		$16.50	"

NOTE ON THE INTENSITY OF TELEPHONIC EFFECT.

By E. Mercadier.

The intensity of telephonic effects depends chiefly upon the the thickness of the diaphragm, its diameter, the intensity of the magnetic field, the form of this field and the induction coils.

The influence of the thickness of the diapragm has already been investigated (vide *Comptes Rendus*, April 5th and 8th, 1889), and it has been shown that for every telephone of a given magnetic field, there is a certain thickness of diaphragm which gives a maximum intensity.

This thickness having been found, it remains to be determined what diameter gives the best effect. The magnetic field of the core only produces a sensible effect within a limited region of the diaphragm, which is not increased by an increase of area. Such an increase, it is true, adds to the flexibility, and favors the vibration of the diaphragm, but, on the other hand, its mass is increased, and therefore more difficulty is encountered in producing these vibrations. Hence, the best diameter will vary with the intensity of the magnetic field, and, therefore, it is necessary to combine the proper thickness with the proper diameter, according to the intensity of the field at disposal. The influence of the field, however, is far from being as great as might be supposed at first sight.

Very varied experiments have been made on this subject in magnetizing the cores of soft iron of the induction coils by means of an electro-magnet, instead of fixing them, as is commonly done, at the poles of a magnet. It is then easy to produce magnetic fields of very different intensities, by causing the current which excites the electro-magnet to vary in intensity. By working in this way it is easy to arrive at a certain limit at which the effect of the telephone does not vary sensibly, this limit being reached when the mass of the iron becomes rapidly incapable, as it where, of absorbing all the lines of force of the field, and more and more of these lines traverse the diaphragm.

This can be tested by scattering some fine iron filings upon the diaphragm, and observing that an increasing portion of the field becomes useless in the production of telephonic effects.

It is necessary, further, to observe that these effects are due to the deformations of the lines of force of the field; that these resist the deformation due to the energy of the waves arising from the voice, according as the magnetic field is more intense, and that this energy is necessarily limited. These remarks apply equally well to the telephone receiver.

It is evident that, other things being equal, the best form of field is that in which the lines of force are perpendicular to the directions of the wire in the coils. Moreover, the variations in the form of the field may be facilitated by the mobility of the field, and this can be increased up to a certain point by the mobility of the magnet and of the cores of the coils.

In summing up the foregoing facts, it seems that the following conditions are those by means of which it is possible to obtain the best results from a telephone, namely :

1. The mobility of the lines of force of the field should be favored.

2. The lines of force should be cut by the greatest possible turns of wire of the coils, and perpendicularly to their direction.

3. The thickness of the diaphragm should be diminished until it is just sufficient to absorb the greatest number of lines of force existing in its vicinity.

4. The ratio of that part of the diaphragm which comes under the influence of induction to the whole of the diaphragm should be increased.—*Comptes Rendus.*

THE CARE OF ACCUMULATORS.

The following directions for the general care of accumulators will be of value to those having charge of such apparatus.

Always charge the cells until they boil well. Never allow the battery to run down till its E.M.F. is below the average of 2 volts per cell. If this should occur when it is known that the charge is not low, an examination of every cell should be made. The acidometers in the cells give an approximate idea of the state of the charge, if they are intelligently observed. Examine the plates every few days by observing their color, and other characteristics. No current meter is of service to measure the charge remaining in the accumulator, since this instrument takes no account of the leakage which occurs before reaching it, nor of local action. As soon as only 25 per cent. of the total charge remains in the cells, the E.M.F. rapidly falls on further discharge. Precautions should be taken to guard against too large a current flowing when charging is commenced, by inserting a resistance, or by means of an automatic governor; also provision must be made against lamps being injured when they are turned on during charging hours, or the moment charging is completed. The instant any fault is noticed, it should be remedied at once, and any dead cell cut out immediately. Do not charge longer than necessary, but see that all the cells boil well; if they are much behind, observe if there is any obvious cause for this. One hour of over-charging is advisable. Occasionally examine the insulation. Observe that the liquid in the cells does not become warm during charging. All measuring apparatus should be compared with standard instruments periodically, so as to avoid falling into errors which may prove destructive to the plates. Feel all connections and switches every now and then, to see if they become warm.

STEAM ENGINE EFFICIENCY.

Prof. Thurston contributed a valuable paper entitled "Steam Engine Efficiencies; the Ideal Engine compared with the Real Engine," to the recent meeting of the American Society of Mechanical Engineers. The ideal engine he defined as one having a non-conducting cylinder and frictionless rubber parts. The real engine would approach this in proportion to the improved conditions of construction and operation. He thought wastes could be reduced "by drying or moderate superheating of the steam, and by adopting high speed of engine to one-half these proportions." It ought to prove practicable to bring the water consumption by the adoption of these high pressures, and by further dividing the wastes by the use of three or four cylinders in series, and by properly supplying dry steam to the engine, down to within ten per cent. of the best figures here obtained for the ideal case. "The real measure of the useful power of an engine is not the indicated power, however, but the dynamo-metric power, as measured by the brake, or at the point at which the engine delivers its energy to the machinery of transmission. A well-built non-condensing engine should have an efficiency of machine at least as high as 92·5 per cent., and engines have been constructed doing better than this. An equally well-built condensing engine should approximate 90 per cent. efficiency of machine, though 85 is a much more common figure." The author then concluded: "It is apparently doubtful whether a vacuum will be found desirable, with its concomitant costs of the air-pump system, when we come to the utilization of these high pressures; unless we can at the same time find a way to reduce the waste of power and the tax thus imposed upon the engine."

AN ELECTRIC VENTILATOR.

L'Electricite notices a curious electric ventilator for supplying a building with Fresh air, either cold or warmed, as desired. An electric motor sets the ventilator revolving and the revolution sucks cold air in. When warm air is desired, a current is sent into a network of fine wire possessing a high resistance, and through the network the air is obliged to pass: the current heats the wires, and the air necessarily becomes heated. The movement of a switch is sufficient to change the character of the air supplied by the ventilator. This system is capable of considerable adaption, and the hygenic results are uniformly good.

CELLULOID.

In view of the tendency to employ celluloid for several electrical purposes the following particulars may be of interest: Celluloid is simply made up of nitrocellulose, camphor and water. It was invented in 1869 in America. In 1876 the industry was introduced into France. Germany also possesses two large factories, whilst the largest in the world is in London. Crude celluloid is a horn-like transparent mass of a slightly yellowish color, and of specific gravity 1·25-1·45. Heat softens it and renders it capable of taking impressions. At 90 deg. it becomes very plastic. It readily kindles. Sulphuric acid rapidly decomposes celluloid on heating, whilst hydrochloric acid attacks it much less vigorously. Nitric acid slowly attacks it in the cold, very rapidly on heating, and the same is true of caustic soda. Acetic acid dissolves it, giving a solution from which water precipitates camphor and nitrocellulose; it is also soluble in ether, acetic ether, acetone, fatty oils, alcohol and turpentine.

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EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

WE are pleased to notice the increasing number of enquiries for information addressed to THE ELECTRICAL NEWS by its subscribers. It is desired that whenever a subscriber meets with a difficulty which he does not know how to deal with, he will send a statement of the case to this paper, and no efforts will be spared to afford him the desired information.

IT is satisfactory to know that the telephone company is making such extensive preparations in connection with its new building in Toronto to place most of the wires underground in the central part of the city, as well as to provide metallic circuits and return grounds in the more distant ones, else the advent of the electric street railway, running all day long as it will have to do, will prove anything but a means of grace to the man who has a constant use for his telephone.

ENGINEERS who desire to obtain certificates in accordance with the Ontario Engineers' Act, will note the fact that a board of examiners will be in attendance at Shaftesbury Hall, Toronto, every Wednesday evening for the purpose of examining candidates for certificates. The fact may not be generally known that examinations are also conducted at Hamilton and Brantford, so that engineers residing in or near those cities will not be under the necessity of going to Toronto.

IT is not likely that there will be much done this winter towards changing the motive power of the Toronto Street Railway. Several cars of heavy rails are to hand and unloaded, but beyond making ready the power house, which is to be located at the foot of Frederick street, the work is likely to be postponed till spring. Stoves are being placed in some of the cars for the winter, but it is likely that they will be replaced by electric heaters when the current supply is avalable.

THE fifth annual dinner of the Canadian Association of Stationary Engineers is set for the evening of Wednesday, Nov. 11th, at the Richardson House, Toronto. The dinners of former years have been occasions of much pleasure and profit, and the forthcoming one will undoubtedly be marked by the same characteristics. In fact, we shall be disappointed if it does not show a larger attendance and greater enthusiasm than any of its predecessors. The event should in a measure serve to mark the progress which the Association has made during the year. Let every member make a note of the date, and see to it that nothing shall prevent him from being present.

ONE or two complaints have been received from persons who favor the formation of a Canadian Electrical Association, that they did not receive invitations to attend the meeting recently held in Toronto with that object. It is a matter of regret that any person interested in the movement should have been overlooked. The purpose was to notify everyone who might be supposed to be interested. Let it be as widely understood as possible that the co-operation of all interested is earnestly desired on behalf of the success of the proposed Association.

IT is sometimes difficult to secure public recognition and support for a new invention, however meritorious it may be. Nobody wants to be the first to experiment with it. It is still more difficult, if not impossible, to induce the public to abandon the use of something which has proved itself to be an improvement, and return to the old order of things. Yet this is the course which the Council of the town of St. Johns, Que., is endeavoring to force upon the citizens with respect to electric lighting. The Council appear to be willing to do without the electric light rather than pay an additional $10 per year for each lamp, as was the understanding when the contract which is about to expire was made. The price paid under the present contract is $40 per year, and the agreement was that at the end of three years the price should be increased to $50. The citizens are manifesting their disapproval of the Council's policy of false economy, and it is safe to say that the councillor who votes to plunge the town into darkness again, will not find himself in the light of public favor when election time comes round.

SEVERAL attempts have been made by the friends of technical education in Toronto to establish means for imparting instruction of this character, but nothing practical has been done. Technicalities arising out of the law regulating the purposes for which municipalities may devote public money, have proved a hindrance to definite action being taken. There has likewise been a great deal of apathy shown by the public towards the movement. One of the newspapers has gone so far as to call in question the necessity for anything of the kind. In assuming such an attitude, it either ignorantly or wilfully places itself in opposition to the views of many of the leading educationists and thinkers of the day, to whom the fact is apparent that scientific theory and practice should go together. We are pleased to notice that during last month an Association was formed in Toronto for the promotion of technical education. The officers are: Prof. Galbraith, President; John Galt, C. E., Vice-President; W. G. Blackgrove, Secretary-Treasurer. The Association calls upon the city council to grant financial aid to assist in establishing technical training schools of science for the benefit of artisans, mechanics and the working classes generally, and to appoint a board of directors, representing the different practical and manufacturing interests of the city, to manage and conduct the affairs of this important movement. The officers of the Canadian Association of Stationary Engineers are taking an active interest in the project, which it is hoped will now assume a tangible form.

AN agitation appears to be developing in Toronto against the use of an overhead wire for street railway purposes, and statements are finding their way into print that are not correct. We are all free to admit that if another way can be found the overhead wire is not desirable, but no other way has as yet proved a commercial success, and it will be a pity if the advent of an electric service with all its advantages is delayed from mere sentimental objections. We have particular reference to a blood-curdling interview with an alderman which recently appeared in one of the city papers. He spreads himself all over the subject with more than the ordinary amount of aldermanic pomposity, and talks about the frightful danger of overhead wires—"death to touch them; actually killed a horse in Buffalo the other day! And if strong enough to kill a horse, where would a human being be?" He evidently is not as well posted on horses as he might be, or he would know that a horse is infinitely easier to kill than a man, and that as a matter of fact there is no record that any person has been killed by a street railway current, and these wires are now used for very nearly, if not quite as many, cars as horses are. The electro-motive

force of electric railway currents is about standardized at 500 volts. This amount can be taken by a healthy person with perfect impunity, and the chances of an invalid handling a wire of any kind, railway or otherwise, are very remote. Members of the disappointed syndicate, by which we mean the enterprising projectors who wanted the city to find the money while they pocketed the profits, have considerable influence in the control of one or two of Toronto's daily papers. It therefore behooves the careful citizen to provide a liberal apportionment of salt to take with the various statements he will presently find in print. The people of Toronto are not likely to get rapid and comfortable transit by electricity except by the overhead system of transmission, and while, of course, it has its disadvantages, there is no doubt but that the benefits derived from its use will much more than compensate for them.

AGAIN it is Niagara. In connection with the utilization of the power of Niagara proposed a short time ago in such glowing and grandiloqent terms by a syndicate of speculators who have purchased land some ten miles from the cataract, it seems strange that the immense water power of the old Welland canal available for instant use is entirely neglected. We have heard of manufacturers who have jumped at the land sharks' glittering bait, and bought lots in this manufacturers' El-Dorado, where they will have to pay for their water power in addition to the cost of the land, while at the same time there are offers in the market of free land, free water power, and exemption from taxation without any takers. It is also interesting in this connection to note the astounding news that Mr. Ferranti has severed his connection with the London Electrical Supply Company. This is the company who were building the enormous machines for electric lighting at a potential of 10,000 volts. It was a bold undertaking, and this "severing of connection" may be taken as an indication of its failure, at least from a commercial point of view. Now, this Mr. Ferranti proposes to come to Canada to exploit this Niagara Falls scheme. Here are his figures, and if he used this kind of arithmetic to his London stockholders, it is no wonder the Electrical Supply Company is "in the soup":—"He estimates that he can deliver 20,000 horse power by electricity at Buffalo at an outlay of $2,000,000 for the plant. If this power were sold at the uniform rate of $50 per annum, it would realize $1,000,000 or one-half of the original cost each year. In view of this, the value of the company's rights, according to Mr. Ferranti's figures, is certainly very great." Well, we should rather say so! But not one word about interest, or capital, nothing for operating expenses, nothing for selling and distributing this large amount of output —nothing about the utter impossibility of getting $50 a year for 20,000 horse power in Buffalo, nothing for maintenance of motors and dynamos and repairs, not a word about the opposition of natural gas which is universally used there, to say nothing of Buffalo being the headquarters of the coal supply for this end of the continent. The failure of Mr. Ferranti's big scheme in London is a poor augury of success here, where the chances to be taken are on an equally gigantic and daring scale.

WE are pleased to notice the increasing interest being manifested in the formation of the proposed Canadian Electrical Association. We are receiving words of welcome and good will from all quarters, and from what we hear, we believe it has met the popular idea. The meeting to be held on the 26th of November, in Toronto, we expect will mark the commencement of a most successful organization. We hope the date will be kept in mind by our electrical friends, and if formal notification be omitted by inadvertence, that it will not prevent any one from being present. Come to Toronto by all means and look up this office for information of the location of the place of meeting. It is proposed that all who were present at the original meeting should be personally notified, as well as all others interested in electrical matters, but it is unadvoidable that some should be omitted. Do not take this as any evidence of neglect on the part of the officers pro. tem., but put in an appearance on the date above mentioned, and make your presence both heard and felt. It is expected that many members will be enrolled from the more distant provinces. Though they will be unable very largely to be present at the deliberations of the Association, they will have the benefit of receiving in printed form the proceedings, together with all information, statistical, practical and legal, that may be compiled as a result of those deliberations. It is also proposed to appoint a committee on legislation, whose province it will be to watch the progress of all legislation that will have any bearing directly or indirectly on electrical interests. There will be much to discuss with reference to practical matters. The development of electrical science is so rapid that there is a constant introduction of new methods and material. It will be the province of the Association to discuss and criticize these new matters. The collective wisdom of the members will thus be made available to the individual, and cannot fail to be a source of profit as well as pleasure. Though there might at first glance appear to be diverse interests which it would seem difficult to reconcile, we cannot but think that an Association of this kind, being a neutral ground on which all can meet and discuss, each from his own standpoint, their various interests, will go very far towards promoting a friendly feeling and a disposition to recognize the rights of all. We trust all who can do so will make a point of attending the initial meeting of the Association to be held in Toronto on November the 26th.

THE craze for deputations that afflicts the average alderman is something astonishing. On the slighest provocation a deputation is appointed to visit an American city in search of information, and usually consists of half a dozen men who have no qualifications either of intelligence or training to enable them to understand the matter in hand. The civic treasury is depleted by some hundreds of dollars, while the deputation from a lack of knowledge of the subject either return in a state of denser fog than ever, or, on the principle that "a little knowledge is a dangerous thing," come back with only a partial or one-sided grasp of the situation and prepared to dogmatically fly off at a tangent from the proper course and wreck what might otherwise be fair legislation. A special example of this absurd waste of public funds, if nothing worse, is to be seen in the deputation appointed to go to Pittsburg to the Street Railway Convention "to find out the best motor for use on the Toronto Street Railway." The City Engineer, who had a perfect grasp of the situation, having resigned in disgust, the acting engineer was appointed to go. Although an otherwise estimable man, he knows not the first rudiments of electricity as applied to railways or anything else. This would have been bad enough, but the climax of absurdity is reached when, finding other engagements prevent him going, the city surveyor and an alderman who is a lawyer are sent in his stead. There was bound to be a deputation, and we suppose that failing the surveyor and the lawyer, rather than the glorious institution of the deputation should be dishonored they would have sent the keeper of the dog-pound and the caretaker of the city hall. The absurdity goes even further when we recollect that the aldermanic and trigonometrical deputation go not to a conclave of municipalities, but to a gathering of street railway companies, where all arguments and discussions are in favor of the railroads and against the municipalities. The chances are, therefore, that if they are able to assimilate any ideas from the gathering at all, they will come back "loaded up the wrong way." But what we want to know most of all is, what have the council to do with the "best motor" anyway? The company can safely be trusted to look after their own interests by putting in the best systems available, without interference born of the partially acquired information of the lawyer and the surveyor. The danger from the citizens' point of view is, that the adoption of improved electric service and rapid transit will be unduly interfered with and delayed, and that crude and impracticable legislation inimical to the best interests of the citizens will be founded upon the imperfectly understood ideas of the civic "deputation."

THE attempts made by some municipalities to go into the business of generating electricity for lighting purposes have already commenced to bear their expected fruit. We have pointed out that there is no more reason in a municipality entering this field than there is for it to go into the manufacture and supply of "plug" hats or corsets, each of which are articles in popular demand and universal use. There is less reason for the non-technical father of the hamlet undertaking to exploit an electrical installation, inasmuch as he knows as much, or rather as little about it as a Jew is popularly supposed to know about

the taste of pork. He is therefore entirely at the mercy of the commission-hunting agents of electric manufacturing concerns, and as he is utterly unable to make a distinction between small lies and great ones, the most imposing and colossal fabricator of the lot carries the day. But the dazzling and monumental character of his promises are not realized, and they "learn too late that men betray." The cost of installation is usually more than double the original estimate, and the cost of production in about the same ratio. Toronto Junction is a case in point. The sum appropriated and passed by by-law will probably not half cover the outlay, and further sums will have to be voted, besides the whole matter having been a source of wrangling and bitter fight for a year past. The worst of the matter is that being "in for a penny they are in for a pound," and the further supplies must be voted or what has already been spent will be thrown away. This is usually the case, but like every other rule it has its exception. The exceptional wisdom referred to is the case of the municipality of Vancouver, Washington Territory. Recognizing their mistake, and being unwilling to get deeper into the mire, they have recently offered their electric light plant for sale, and advertised for proposals for its purchase. In the notice it was stated that "Each bid must be accompanied by a bond in the sum of $1,000, conditioned that, if the bid is accepted by the city, the successful bidder will enter into contract with the city to make the purchase as proposed within 30 days. The city reserves the right to reject any or all bids. Bidders must state the rates they will charge for street and house lights in the event of purchase, which rates must be graduated for a series of not less than ten years, decreasing to an agreed minimum upon the attainment by the city of a certain population. The purchaser will be required to give adequate bonds for the faithful performance of his contract." Thus we see how time brings its revenges, but it requires some pretty hard knocks in the way of financial loss to pound sense into the head of the average civic representative when it is the public money and not his own that he is experimenting with.

STEAM HEATING.

AT this season of the year the heating of houses is a subject of interest to nearly every one. Many of the readers of our paper are especially interested in steam heating, and are now engaged in getting such appliances ready for the winter's work.

The most important part of a steam heating apparatus is the boiler, and next to that in importance is the furnace. Unless these are suitable and of sufficient capacity, all the rest of the apparatus will be found unsatisfactory, no matter how skilfully it may be done. Some steam fitters advocate the use of sectional boilers of cast iron, and containing the furnace within the parts of the boiler. These, no doubt, are cheaper and more convenient to sell and erect in place; but when that much has been said in their favour, the list of their good qualities is about complete. In some circumstances it is necessary to have a boiler in which steam is quickly raised, but it should be remembered that a boiler in which steam can be quickly raised is also one in which it will quickly go down, should the fire become dull.

For this climate, with its great variations of temperature during the winter, the boiler of a steam heating apparatus should be made large enough to give ample steam for the coldest weather, and the furnace part should be so arranged that the fire may burn slowly and yet maintain a steam pressure. The boiler should contain a considerable quantity of water, and it will be found of advantage to have the furnace of brick, so as to form a reservoir of heat, which will be radiated to the boiler whenever the fire becomes dull.

The boiler and furnace should be of such capacity and so arranged as not to require the constant attendance of the man in charge. The first cost may be more, but the annual expenditure for fuel, attendance and repairs will be less when the boiler is large and the furnace made so that a slow burning fire keeps up steam. The comfort and satisfaction obtained will more than repay for the greater outlay.

In another article the size of boiler and furnace in proportion to the amount of piping to be kept hot will be discussed—at present it is proposed to say something about getting ready for winter.

The boiler, it is assumed, is all right and not requiring any repairs; what, then, should be done in order to get ready? The boiler should be carefully gone over, and all dirt and dust removed from it and from the furnace. This should be done, even though it was all cleaned out in the early summer. The next thing to do is to remake the hand hole and man hole joints. The hand hole joints should be very carefully made, as they should be absolutely tight in order to prevent the slightest amount of leakage. Corrosion of the boiler head soon follows a little leakage at the hand holes. In making these joints, it is a good plan to use moderately thick rubber, and to make a paste of black lead and oil, and put it on both sides of the rubber. The hand hole cap should not be screwed up too tightly when the boiler is cold, and should be screwed up after steam has been up or the water at the boiling point. All the valves about the boiler and its connections should be examined, and the spindles properly packed if new packing is needed. Then close the blow-off cocks, see that any check valves either in the feed or return pipes are in order, and while free to rise have not too much lift. The lift should never exceed one-fourth the diameter of the valve, and may be less. Open the valves on the steam and return pipes, and then turn on the water and fill the boiler to within a couple of inches of the level at which it is intended to keep the water when steam is up.

While the water is being run in, the guage cocks, or safety valve, should be open to allow the air to escape from the boiler. The fire should then be lighted, and the water slowly heated until steam is raised. When steam has begun to flow through the pipes the valves at all the radiators should be opened, and any requiring packing marked for attention by re-packing. If any radiators do not heat, the air valves should be opened to allow the air to escape.

When steam is up the return pipe should soon become warm, showing that circulation is going on throughout the apparatus. If it does not become warm, the cause of the stoppage of circulation should be searched out and removed.

A NEW ARC DYNAMO REGULATOR FOR THE BALL DYNAMO.

A NEW dynamo regulator for constant current machines has just been patented by Mr. Royal E. Ball, and the device is being attached to the new Ball dynamos now being manufactured. The device consists of a disc of magnetic metal working in a cavity left in the yoke between the magnets, the disc being mounted on the shaft where it is provided with ball bearings, so that there is little friction to speak of. Attached to the disc is the yoke carrying the brushes, which are held in the required position by the action on the disc of the magnetism of the field magnets. A number of grooves are cut in the disc to remove a portion of the metal, so that as the magnetism of the fields increase, the thicker parts of the disc are drawn more nearly into the center of the field. The lack of equilibrium in the disc is the only device used to revolve the disc and carry the brushes into the region of the highest potential on the commutator. As the current of the machine increases, the increased magnetism of the field attracts the disc and moves the brushes on the commutator, thus cutting down the current to the required amount.

The Ball dynamo possesses such good practical qualities as show it to be a very efficient machine; and the convenience with which it can be handled by itself or when coupled with dynamos of a different make, have gained for this machine considerable praise from those who have used it for lighting purposes. The only particular objection that we have ever heard offered to the machine, was that it was not automatic in its regulation, although it can be perfectly regulated by movement of the brushes. Now that the new regulator is being applied to all machines built, the last lingering objection to this dynamo will have been overcome.—*Practical Electricity.*

No oil has been made, says a contemporary, that can economically lubricate all the journals of a mill. An oil running a heavy Corliss engine would not do to run a spindle or a fast-revolving dynamo. The former runs slowly and has great pressure and strain on its journals, and consequently requires an oil which will not spread too quickly, but with low gravity and high viscosity. The latter needs a pure mineral oil, viscous and quick, to enable it to enter into the closest parts of the bearing as rapidly as the speed at which it revolves necessitates.

ON THE RELATION OF THE AIR GAP AND THE SHAPE OF THE POLES TO THE PERFORMANCE OF DYNAMO-ELECTRIC MACHINERY.*

THE object of this paper is not to deal with the subject in a new light, but to add to its literature a limited amount of data, the deductions from which go to establish the correctness of the ideas, and the utility of the suggestions put forth in the papers read by Messrs. Swinburne & Esson, at the meetings of the Institution of Electrical Engineers on February 13 and 20, 1890. Up to the time of the publication of these papers the air gap was usually treated by contributors to electrical literature as an evil in a dynamo, having a necessary existence, and the smaller that it could conveniently be made the better. The shape of the poles had often been spoken of as having a somewhat decided effect on the performance of the dynamo, while but little had been said regarding the cause of such an effect.

There exists some difference of opinion as to what should be known as the number of ampere turns on an armature. For our

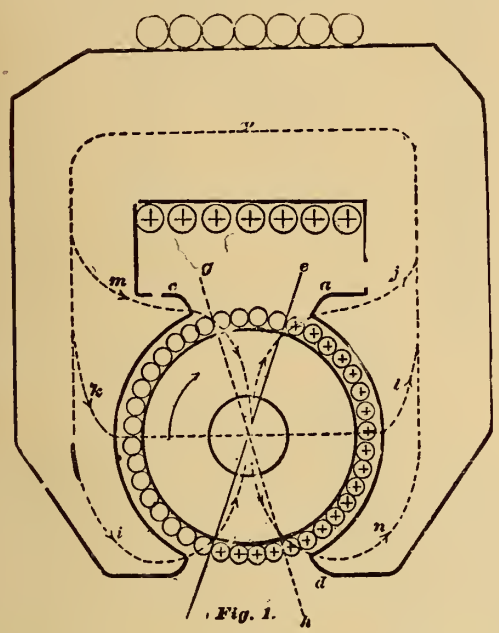
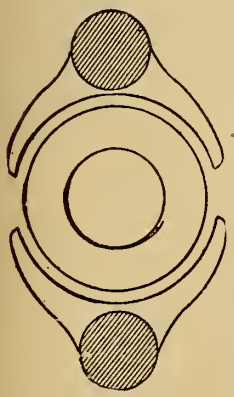


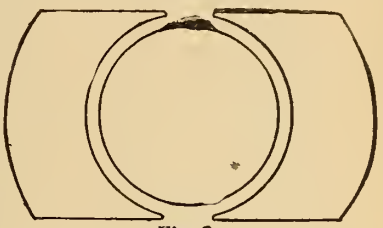
Fig. 1.

present purpose we will assume that the armature ampere turns equal

$$\frac{\text{The number of conductors on the surface of the armature.}}{\text{Number of poles.}} \times \left\{\begin{array}{l}\text{Strength of current in the}\\ \text{armature conductors.}\end{array}\right.$$

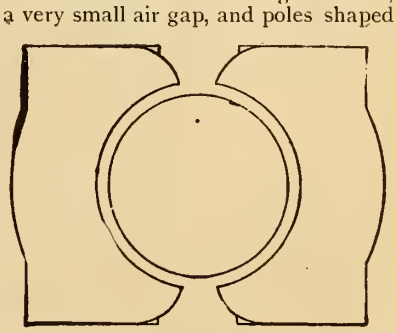
Referring to Fig. 1, it is evident that, when we consider the magnetic forces acting in a working dynamo by the route *o*, *i*, *j*, *o*, the entire number of ampere turns on the armature are directly opposed in action to the ampere turns on the field. By the route *o*, *m*, *n*, *o*, all the ampere turns on the armature, except those that lie between the double angle of lead *g*, *e*, are acting with the field ampere turns, while those between *g e* are opposed to the same. Therefore, by this route, the total number of ampere turns actually aiding the field ampere turns is the total number of armature ampere turns, minus twice the number of ampere turns that lie between the double angle of lead. By the route, *o*, *k*, *l*, *o*, the number of ampere turns acting is the number of ampere turns on the field, minus the number of ampere turns that lie between the double angle of lead. We can then estimate with ample practical accuracy the magnetic density in the air gap at all points for any given total amount of magnetization through the armature. The ampere turns that lie between the double angle of lead are opposed to the action of the field ampere turns at all points. It is evident that the portion of the armature ampere turns not included between the double angle of lead will increase the magnetization through the air gap by the route *o*, *m*, *n*, *o*, just as much as they diminish it along the route *o*, *i*, *j*, *o*, as long as magnetic saturation does not take place in the strengthened pole corners *c*, *d*. If the pole corners are thin, as in the types shown in Figs. 2, 3 and 5, saturation is apt to occur. It is then that the magnetic resistance increases by the route *o*, *m*, *n*, *o*, and the magnetic density by this route is no longer increased by the same amount that it is diminished along the route *o*, *i*, *j*, *o*. On the other hand, when the pole corners are fashioned, as seen in Figs. 4 and 6, so that saturation in the strengthened pole corners cannot occur in practice, the current in the armature can produce no modification of the total amount of magnetization through it, other than that which is produced by the action of the ampere turns that lie between the double angle of lead. This action can always be compensated for by putting an equivalent number of series ampere turns on the field acting with the field ampere turns. The double angle of lead can be determined with sufficient accuracy, for with pole corners slightly extended at the center (see Fig. 11) the diameter of commutation at all loads is very near the weakened pole corners. The pole corners are slightly extended at the center, so that the coils always enter the field of the weakened pole corners gradually. The electromotive force developed in the coils as they pass under the poles can never be far different from that actually needed to reverse the current in the coil when passing under the brush. In this way the point of commutation in a dynamo can be kept the same when carbon brushes are used without undue sparking, as long as the armature does not reverse the magnetization under the weakened pole corners.


Fig. 2.


Fig. 3.

From the discussion of the magnetic relations of an armature to its field in a dynamo, in connection with Fig. 1, it is seen that the magnetization in the air gap under the weakened pole corners becomes zero, when the armature ampere turns are equal to the ampere turns on the field, whose magnetizing force is impressed between its pole faces through the armature. This impressed magnetizing force is that due to the difference between the total number of ampere turns on the field and the number of ampere turns required to set up the magnetization through the field cores, from pole face to pole face. In order to commutate the current without spark at the commutator the magnetization in the air gap under the weakened pole corners dare never be allowed to become zero. It follows, then, that the field ampere turns, impressing a magnetizing force between the pole faces, must always be somewhat in excess of the maximum number of ampere turns on the armature. The amount of this excess need only be sufficient to insure a positive field at *a* and *b*, Fig. 1, strong enough to reverse the current in the coils as they are commutated. When a certain amount of magnetization is to be set up through an armature, with the application of the magnetizing force of a given number of ampere turns impressed between the pole faces, we must provide the requisite amount of magnetic resistance between these pole faces. The value of this resistance will have to be such that the impressed field magnetizing force will establish the desired amount of magnetization. This resistance in most cases is best provided for in a proper length of air gap. In general, it is found best to avoid heating in the armature core, as far as consistent, by the use of comparatively low magnetic densities for wrought-iron. The magnetic resistance of the armature core, under these circumstances, is very small and may be neglected.

The magnetic resistance between the pole faces is occasionally provided for largely, either through a saturated core of a ring armature, saturated lugs on armatures where the wires are placed in grooves, or both. This, in addition to what air gap may be necessary from a mechanical point of view, go to make up the total amount of magnetic resistance that is provided between the pole faces. Machines of this order have been developed largely through the old and rather expensive method of experimentation. This method has given us some types in which ordinary results are arrived at through rather extraordinary means. Take the case of a machine with a ring armature, wires wound in grooves, a very small air gap, and poles shaped somewhat as shown in Fig. 2. Such a machine, operated as a dynamo, may require only a quarter of the number of ampere turns that it will have on the armature at full load for field excitation in order to produce a certain electromotive force at a given speed. Yet this machine produces a fairly constant potential at the brushes, under all variation of load, and without undue sparking at the commutator, in the following manner: For the production of a constant electromotive force at constant speed the total magnetization through the armature must remain constant. At no load one-fourth of the ampere turns needed on the field at full load are provided by a shunt winding. This shunt winding is sufficient to set up the total amount of magnetization for the production of the normal electromotive force of the machine when there is no current in the armature. Now, in order to take the normal current from the armature without reversing the magnetization under the weakened pole corners, three times as many series ampere turns as there are shunt ampere turns must be added to


Fig. 4

* Paper read before the American Institute of Electrical Engineers, New York, September 22, 1891, by Harris J Ryan.

to the field. The addition of these series ampere turns must not increase the total amount of magnetization through the armature, which is accomplished by the thin pole corners. The strong pole corners become saturated when the armature is furnishing even a small amount of the normal current for which it is designed. For most values of the current, then, the armature ampere turns tend to diminish the magnetization under the weakened pole corners, but cannot increase it correspondingly under the saturated pole corners. The action of the series ampere turns on the field prevents the reduction of the magnetization under the weakened pole corners to zero, while the saturated portion of the pole pieces prevents the increase of the total magnetization through the armature, and thus a constant potential is maintained.

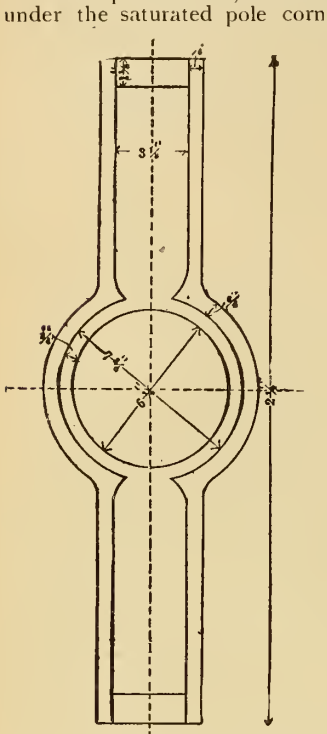


Fig. 5.

The "armature characteristic" IV, plotted in Fig. 7, was taken from the machine of the above sort, built with cast-iron fields. The cross-section of the field cores proved, on trial, to be too small, and became strongly saturated at full load, while they were quite a little under the point of saturation at no load. This curious result for a constant potential generator was due to the increased magnetic leakage produced as the series ampere turns on the field came up with the load. Saturation took place, as the curve indicates, when the armature furnished a current of about 140 amperes, and no possible compounding could ever make this generator produce even approximately a constant potential, with variation of load. Steel cores of the same dimensions were substituted for the cast iron cores. Saturation did not occur in them due to magnetic leakage. The pole corners were very thin, as in Fig. 2, and the "armature characteristic" III was obtained. The machine was then furnished with a shunt winding that produced a slightly smaller number of initial ampere turns than curve III indicates as required to produce 125 volts, and with series turns at such a number that the total number of ampere turns on the field for any current developed by the armature is shown by the broken line drawn through curve III. It was under these conditions that the machine performed in the manner described above, and not vary more than five per cent. from the normal electromotive force on either side, or a total variation of 10 per cent. It was then almost entirely rebuilt. The armature was provided with a core that was considerably larger in cross-section, and the maximum magnetic density used in it was 11,000 lines per square centimetre, as against 20,000 used before. The lugs on the core were dispensed with and the wires wound on the surface of the core. The poles were made of cast-iron, and fashioned to accord more nearly with those in Fig. 3. The air gap required 10,000 ampere turns to set up the magnetization through it at no load, while the armature ampere turns were

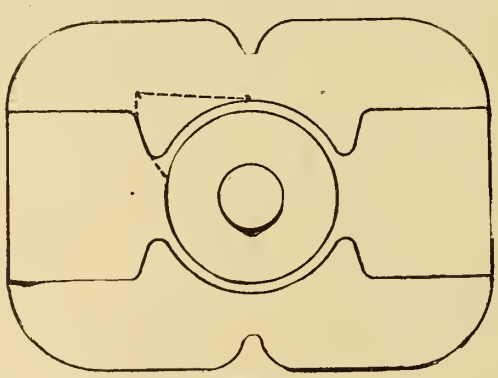


Fig. 6.

8,000 at normal output, so that series ampere turns had only to be added to counteract the action of the ampere turns on the armature that lie between the double angle of lead, to increase slightly the electromotive force by the amount equal to the fall of potential through the armature caused by its resistance, and to compensate for the slight effect of the pole corners that still became saturated to a limited extent for the higher outputs. It should be remembered that the magnetic leakage that takes place between the adjacent north and south pole corners, one of which is strongly and the other weakly magnetized, plays an important part in saturating thin pole corners. It is evident that unless the "armature characteristic" is a straight line, as in curve I, Fig. 7, that the machine cannot be made to regulate for constant potential with a high degree of refinement. The poles were again changed and shaped as in Fig. 4, when an "armature characteristic" given in curve I was obtained and the proper number of shunts and series ampere turns for a refined degree of regulation were readily decided upon. These experiments confirm what has been said above, and show how useless have been the attempts to diminish the air gap beyond certain limits.

It was shown on the outstart how we can calculate the actual magnetic densities in the air gap for any total magnetization through the armature for any armature current. The results of the following experiments confirm the correctness of these methods. The diagrams in Fig. 8 give the values of the magnetic density at all points of the air gap of a generator, produc-

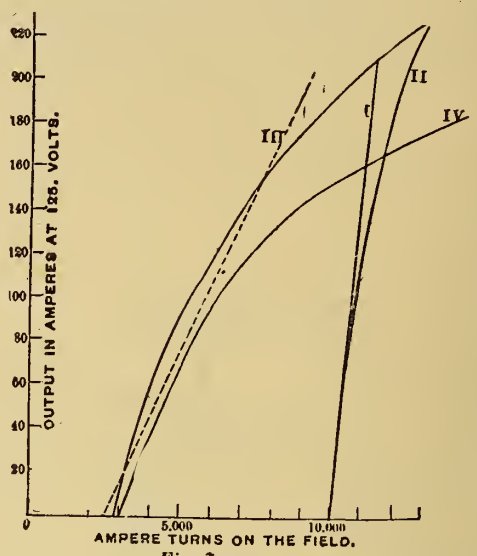


Fig. 7.

ing 125 volts at the brushes and 80 amperes. The following are its dimensions and data:

Diameter of armature core	6.25 in.
Length of armature core	12. in.
Diameter of bore of poles	7.19 in.
Double depth of air gap	.94 in.
Armature sections	50.
Turns per section	2.
Resistance of armature	.06 ohms.
Poles shaped as in Fig. 3.	
Shunt turns on field	6400.
Field current, no load, 125 volts	1.48
Field current, full load, 125 volts	2.10
Speed	1600.
Carbon brushes used without lead.	

The "armature characteristic" curved considerably, indicating that the pole corners become saturated. It is evident, too, that the normal magnetization in the pole corners, in addition to the magnetic leakage, which is greater there than anywhere else, produced saturation in all pole corners, even with no current in the armature. For, at full load, there were 4,000 ampere turns on the armature, while 4,000 series ampere turns had to be added to the field that produced 125 volts at no load to keep the electromotive force the same. Therefore, at full load, we have the same number of ampere turns acting through the weakened pole corners as at no load, and the total amount of magnetization has only been increased five per cent., to compensate for the resistance of the armature conductors. The conditions, however, are not the same, for there are just 4,000 more ampere turns to cause magnetic leakage at the pole corners, so that on the whole the magnetization in them is increased. This increase of magnetic density in them greatly increases their magnetic resistance, for they are saturated to begin with. It is on this account that we find the magnetization under the weakened pole corners diminished when apparently the forces acting have not

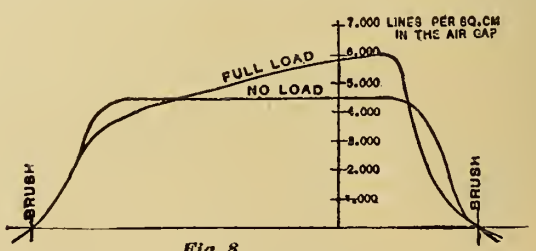


Fig. 8.

been changed. The magnetization under the strengthened pole corners through the air gap is increased more than it is diminished by the effect of the added magnetic leakage, through the 8,000 additional ampere turns, that act to produce magnetization by this route through the armature.

In Fig. 9 the diagrams show the magnetic action of the armature of a 10 horse-power, 110 volt motor, with poles fashioned as in Fig. 6. Measurements of the magnetic leakage were made on this motor, and the results indicate that the shape given to the pole corners avoided saturation in them even at full

load. The double angle of lead was almost 60 degrees. The ampere turns embraced by it on the armature were partially compensated for by nine series turns on each of the consequent fields. The remainder of the armature ampere turns that lie between the double angle of lead served to weaken the field by just the amount required to produce a constant speed. The following figures give additional data on this motor :

Diameter of armature core	8.33 in.
Diameter over all	9. in.
Bore of poles	9.38 in.
Double air gap	1.05 in.
Shunt turns on field	2200.
Shunt current at 110 volts	3.55
Ampere turns on the field at 110 volts	7800.
Ampere turns on armature at full load	5750.
Armature sections	48.
Turns per section	3.
Speed	1200.

The ampere turns required to set up 2,600 lines per square

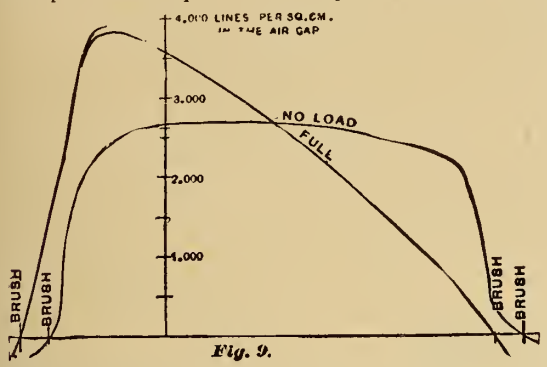


Fig. 9.

centimetre through a distance of 1.05 inches or 2.64 centimetres in open air :—

$$\frac{2600 \times 2.64}{1.26} = 5,600.$$

This is the number of field ampere turns that exerted their magnetizing force between the pole faces through the armature. The ampere turns acting through the weakened pole corners are, therefore, very near zero, which is entirely corroborated by the fact that the magnetization was observed to be zero at this point. See full load curve in Fig. 9. Through the strong pole corners the ampere turns acting were the 5,600 of the shunt ampere turns, + the 720 of the 9 series turns + the armature ampere turns, 5,750 – twice the ampere turns between the double angle of lead, 2. [.3 + 5,750], or 3,400 = 8,670, which will produce a magnetic density through an air gap of 2.64 centimetres depth of

$$\frac{8,670 + 1.26}{2.64} = 4,100,$$

while the actual magnetic density measured at this point was 3,950, an agreement within the possible limit of error.

In Fig. 10 are given curves showing the magnetic performance of an armature, with its conductors laid in deep narrow grooves, as shown in Fig. 12. The clearance on each side was one-sixteenth of an inch, making the double air gap one-eighth of an inch. Additional dimensions are as follows :

Diameter of the armature core	6. in.
Length of armature core	6. in.
Resistance of armature	.34
Number of sections	64.
Turns per section	3.
Output, amperes	20.
" volts	100.
Speed	1800.

Curve I in Fig. 10 shows the distribution of magnetization at 112 volts, no current, a speed of 1,800, and a field excitation of 2,600 ampere turns. Curve II shows the magnetic distribution for an output of 97 volts and 24 amperes, at a speed of 1,800,

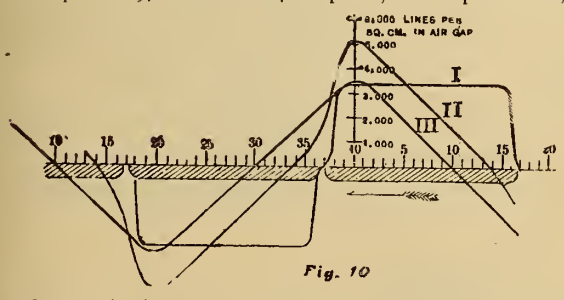


Fig. 10

and a field excitation of 2,600 ampere turns. Curve III shows the magnetic distribution at an output of 40 volts and 20 amperes, at a speed of 1,800, with a field excitation of 750 ampere turns. This same excitation, when the armature furnished no current, produced an electromotive force of 48 volts, at a speed of 1,800 revolutions. The poles were shaped as in Figs. 11 and 12, but modified as explained below. In making these experiments carbon brushes were used, and their position maintained at the normal diameter of commutation. An average magnetic density in the air gap of 3,400 lines per square centimetre was required to produce an electromotive force of 112 volts. The grooves on the armature in which the conductors were placed occupied one-half of the armature surface, so that the actual magnetic density in the air gap was 1.8 times this average magnetic density. The ampere turns required to set up this magnetic density in the air gap were

$$\frac{.125 \times 2.54 \times [3,400 \times 1.8]}{1.26} = 1,520,$$

which is the number of field ampere turns whose magnetizing force is impressed between the pole surfaces through the armature, when it furnishes 112 volts and no current. The ampere turns on the armature at a current of 24 amperes are

$$\frac{2 \times 64 \times 3 \times 12.}{2.} = 2,300.$$

as against 1,520 impressed by the field. Under these circumstances the magnetism under the weakened pole corners is reversed, as is also clearly indicated by Curve II in Fig. 10, or the curve *c, e, d, f, c*, in Fig. 11. This curve also shows that the magnetic density under the strong pole corners was 5,100 lines per square centimetre. Now, in building this machine, six longitudinal slots, 1¼ inches deep, were cut in each pole immediately back of the surface, which enables us to be sure of the exact densities in the pole corners for a given distance. For a depth of 1¼ inches immediately back of the pole faces these slots took up one-half of the cross-section of the poles. Then a density, therefore, of 5,100 really means a density of 10,200, or a strong saturation for a distance of 2½ inches in the cast-iron of the poles. The magnetizing force required to produce 10,200 lines per square centimetre through cast-iron is 200 per centimetre length. Therefore, the ampere turns required to establish this density through 2½ inches are

$$\frac{2.5 \times 2.54 \times 200}{1.26} = 1,000.$$

The total number of ampere turns acting to produce magnetization through these strong pole corners was the sum of the field ampere turns that impressed magnetizing force from pole face to pole face through the armature, and the ampere turns on the armature covered by the poles. The poles covered approximately 85 per cent. of the armature surface, making this value : 1,500 × [2,300 × .85] = 3,400. Of this number, as was just shown,

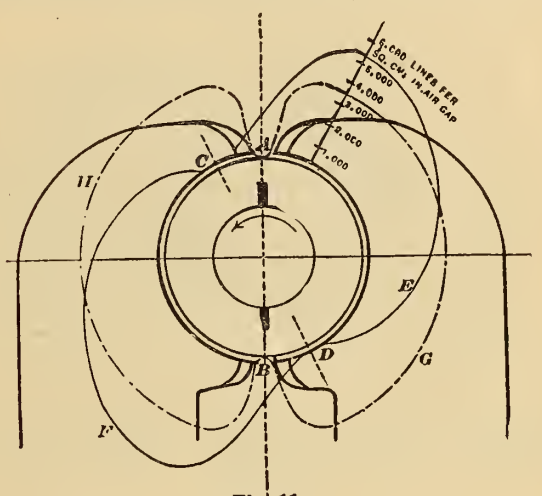


Fig. 11.

1,000 were utilized in producing the magnetic density of 5,100, through the saturated portions of the poles. The remaining 2,400 ampere turns exerted their magnetizing force in producing the average magnetic density of 5,100 through the air gap, and affords another opportunity of checking these ideas of the action of the armature on the field. For the ampere turns required to set up an average magnetic density of 5,100, through the air gap under consideration were :

$$\frac{[1.8 \times 5,100] \times .125 \times 2.54}{1.26} = 2,300,$$

which checks with the above value as well as could be expected. When the armature furnished 24 amperes, the electromotive force at the brushes was 97 volts, while with no current it was 112 volts. Of this drop of 15 volts eight are accounted for by the resistance of the armature, and the extra seven were caused by the saturated pole corners. By operating this same machine at an electromotive force at which the pole corners could not saturate with normal output of current, we have demonstrated for us in a very striking manner that the armature ampere turns cannot change the total magnetization established through the armature by the field when the pole corners do not saturate. The electromotive force, with the armature current at zero, was brought to 48 volts with a separate field excitation of 750 ampere turns. Then when the armature was allowed to furnish 20 amperes the electromotive force at the brushes dropped to 40 volts. Of this drop of eight volts seven were produced by the resistance of the armature. Yet the field is powerfully distorted by the armature current, as may be seen by reference to Curve III, Fig. 10, or the curve A, D, C, B, in Fig. 12. Even with this very great rearrangement of the magnetization produced by

the armature current, the total magnetization set up by the field is practically unchanged. The difference of potential on the commutator between the points A, B, Fig. 12, was observed to be 72 volts. This excess of electromotive force over that which was produced at the brushes the figure shows clearly to be due to magnetization produced by the armature through itself and the strengthened pole corners. The points where the field is zero are at A, B. They mark the diameter through which the ampere turns encountered on the armature are just equal and opposite in action to the ampere turns of the field that impress a magnetizing force between the pole faces through the armature. A simple computation will show that this is true. The field ampere turns that impress magnetizing force between the poles when the armature produced an external electromotive force of 48 volts are

$$\frac{1,520 \times 48}{112} = 650.$$

The ampere turns on the armature opposed to the magnetization set up the route A, B, are $\frac{12}{40}$ of the total number of ampere turns on the armature [see Fig. 12], or,

$$\frac{12 \times 64 \times 3 \times 20}{40 \times 2} = 576.$$

This is a fair agreement when we consider the accuracy with which the original data may be determined.

Mr. Esson, in his valuable paper above referred to, discussed the requisite features for a generator of constant current with closed coil armatures, in which regulation is effected by shifting the brushes. He stated that the field should be uniform at all points under the poles, and that the armature cord should be saturated. These statements are a little misleading. The magnetizing force impressed by the field ampere turns must be uniform at all points between the pole surface. This is accomplished by proportioning the poles so that the strongly magnetized pole corners will not become saturated when the brushes

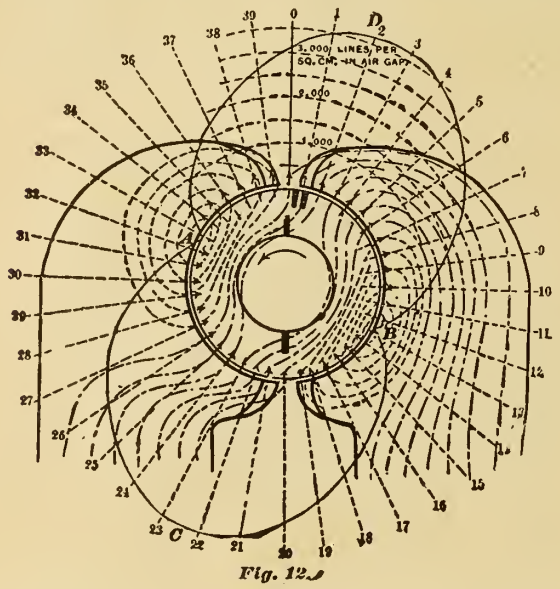


Fig. 12.

have their extreme position for the development of the highest electromotive force that the machine is to produce. The air gap is made of such a depth that the ampere turns required to set up the magnetization through the armature, without current, and for the production of the highest electromotive force that the machine will be called on to give, shall be a little more than the armature ampere turns when it furnishes its normal current. Then as long as the brushes are kept under the pole faces the non-sparking point will be wherever the brushes are placed. This will be the case whether the armature is or is not saturated. A practical demonstration is found in the following experiment: A Siemens & Halske dynamo, with magnet and armature cores, whose shape and dimensions are shown in Fig. 5, was used.

Length of armature core	7.25 in.
Number of armature sections	56.
Turns per section	6.
Revolutions	1000.
Output in volts	50.
" amperes	30.

The field was separately excited with 4,000 ampere turns on each of the sets of consequent poles. Regulation could then be effected for a constant current in the armature of 22 amperes, by shifting the brushes from no electromotive force to 35 volts without the slightest sparking, even when metallic brushes were used. Within this limit the pole corners did not saturate. The field cores were wrought and the yokes cast iron. When the armature circuit was broken it was found that the field excitation of 4,000 ampere turns produced an electromotive force of 50 volts. The magnetic density in the field cores, including leakage, was only 11,000 lines per square centimetre. Therefore, of the 4,000 ampere turns on the field not more than 200 were applied in setting up the magnetization from pole face to pole face through the field cores. It is safe to assume, then, that of these 4,000 ampere turns 3,800 were active in producing a magnetizing force impressed uniformly over the pole faces through the armature. This same value is obtained by the method adopted in the previous cases. That is, by calculating the magnetic density in the air gap when 50 volts were developed, and then deducting the number of ampere turns required to establish such a magnetic density through a one and one-half inch air gap. As to the armature, when it produced 22 amperes its ampere turns numbered

$$\frac{2 \times 56 \times 6 \times 11}{2} = 3,700,$$

or an excess of 100 ampere turns impressed by the field over and above those on the armature. As long as this same number of ampere turns was maintained on the field it was not possible to regulate for a constant current of a lower or a higher strength without sparking. The impressed field ampere turns are in excess of the armature ampere turns by that amount which is just sufficient to produce a weak positive field that will reverse the current in the coil when its terminal bars at the commutator pass under the brush. When regulation is effected by this means it is seen that all pole corners are alike magnetized and at the center of the pole faces the magnetization is zero when the machine is short-circuited. At full output, at the highest electromotive force, the magnetization under the one set of pole corners is almost zero, and under the other set it is at the maximum value that is ever obtained. In a generator of this type when the poles are made stout enough at all points, the total amount of magnetization through the armature, at all loads, will remain at a constant value.

What has been said of dynamos applies equally well to motors. In a motor the armature rotates in an opposite direction when field and armature currents remain the same as in a dynamo. The electromotive force of self-induction, caused by the reversal of the current in a current has not changed, while the electromotive force developed in the coil by the field has changed sign with the change of the direction of rotation. The result is that the reversal of the current in an armature section must take place in a weak field of an opposite sign in a motor from what it does in a dynamo, when sparking is to be avoided entirely.

The action of the current in the armatures of multipolar dynamos and motors will be the same as that found for two pole machines.

BOILERS FOR 120 POUNDS PRESSURE.

THE following table, taken from *Power and Transmission*, shows how thick cylindrical boiler shells of 50,000 pounds iron will have to be to stand 120 pounds pressure. It allows a safety factor of six, and deducts 44 per cent. for single riveting, and 30 per cent. for double:

Diam.	THICKNESS.		Diam.	THICKNESS.	
	sing. riv.	d'bl. riv.		sing. riv.	d'bl. riv.
24	.3082	.2468	50	.6420	.5142
26	.3338	.2674	52	.6676	.5348
28	.3596	.2880	54	.6934	.5554
30	.3852	.3086	56	.7190	.5776
32	.4108	.3290	58	.7446	.5966
34	.4366	.3496	60	.7704	.6170
36	.4622	.3702	62	.7960	.6376
38	.4840	.3908	64	.8218	.6582
40	.5136	.4116	66	.8474	.6788
42	.5392	.4320	68	.8732	.6994
44	.5650	.4526	70	.8988	.7200
46	.5906	.4730	72	.9244	.7404
48	.6164	.4936			

BELTS FOR DYNAMOS.

IT is best when purchasing a belt for driving dynamos to have it well stretched before placing upon the machine. New belting stretches very much and gives a great deal of trouble until it settles down to its work. Before measuring for a belt, screw the dynamo upon its slides as near to the engine or driving pulley as possible. For moderate powers the belt should have one inch in width for each horse power transmitted, running at a speed of 1,000 feet per minute. It is impossible to avoid a slight slipping of the belting when new, but moving the dynamo from the driving pulley by means of the slides will tighten it. Care must be used to keep the belt from being too tight, as a belt that is too tight is as bad as one too loose. Thin, flexible belting is generally used for dynamo work, but rope driving is coming rapidly into favor for large dynamos, a single or multiple rope being used upon a groove pulley. There is less liability to loss by slipping in this method, and there is no stoppage to the plant by a belt coming off of the pulley.—*Electrical Age.*

The Kingston Locomotive Works recently presented a four h. p. gas engine valued at $500 to the Carruthers Science Hall of Queen's University.

SPARKS.

A new engine with a fly-wheel measuring 18 feet in diameter and 4½ feet across the face, is being put into the Electric Light & Tramway Co.'s premises at Victoria, B. C.

Messrs. Patterson & Corbin have been granted exemption from taxation for ten years by the St. Catharines city council, and purpose engaging in the manufacture of street cars, etc.

An American exchange says: The North American Phonograph Company, of New York, have commenced legal proceedings against every Edison phonograph now in Canada that has been obtained under an American lease. It is understood that a number of persons are operating the phonograph illegally, and under the terms of the lease are subject to seizure by the company, and the lease cancelled.

Mons. Redier has invented an ingenious apparatus for indicating the revolutions made by the wheels of rapidly driven machinery, especially of dynamos. The indicator requires no attention on the part of the operator, and works without the aid of a chronograph. It is, in fact, perfectly automatic. In order to ascertain the number of revolutions made per minute by a wheel, the needles are brought to zero by means of a button, and a triangle is appended to the extremity of the axis, the speed of which it is desired to determine. The two needles which record the turns, and the hundred of turns, put themselves in motion, and stop when the operation is completed. It is only necessary then to read the indicated figures. It is not essential to follow the action, which occupies about twenty seconds. The mechanism stops of its own accord when the needles have arrived at the desired stage.

"Hanging in a room in my shop," said an electrical manufacturer, "is a 32 candle power Bernstein series incandescent lamp, fed from an arc circuit. The lamp hangs about five feet below the ceiling, and the switch, operated by pulling a string, is placed on the ceiling. The floor in that room is of dry wood about five inches thick. If I go in their after dark, when the current is turned off the lamp, and wish a light, I simply put out my hand and feel around for the lamp. When my fingers come within a few inches of it the whole bulb begins to glow with a mellow light, as if it were filled with white smoke. This gives me enough light to find the string attached to the switch, which I pull to turn on the current. Then the lamp burns as usual. But what makes that lamp glow when there is no current on?—*Electrical Review*, N.Y.

Mr. Thos. Laing Kay, of Hamilton, secured a patent on August 25th last, on a storage battery, for which the following claims are made: Each individual plate after being filled with electrolytic compound, is covered with a perforated sheet of lead, rubber or equivalent material that will resist the action of the acid to prevent the compound from falling out of the plates. The combination, with the cells of projecting lugs made to be secured to horizontal bars, said bars provided with upward lugs so that when two or more batteries are placed side by side the lugs of the bars come together, and are secured by a rectangular clamp with binding screw and a rubber washer, interposed between the point of the screw and the lug. Perforated rubber plates or the equivalent non-conducting substance formed with non-conducting projections on each side interposed between the positive and negative electrolytic plates to prevent said plates from buckling or coming in metallic contact.

TENDERS

FOR

Electric Light Franchise

Proposals will be received by the undersigned up to SATURDAY THE 28TH DAY OF NOVEMBER, 1891, for the Commercial and Interior Lighting of the Town of Toronto Junction. (The street lighting plant is owned by the Corporation.)

Proposals to be upon the basis of the franchise for the Town for a term of Five years and to state the price per light of 16 candle power to be charged to consumers, also the price of fixtures, tenderers to have the use of poles owned by the Corporation on streets where such are erected. Proposals also to state in the alternative what price will be charged to consumers if the franchise is granted free.

Full particulars on application to the Chairman of Committee on Fire, Light and Police.

ROBT. J. LEIGH,
Clerk.
Box 313, West Toronto Junction.

Clerk's Office, Oct. 27th, 1891.

TENDERS WANTED

TENDERS WANTED — TENDERS WANTED

A Weekly Journal of advance information and public works.

The recognized medium for advertisements for 'Tenders.'

CANADIAN CONTRACT RECORD

TORONTO.

Mr. C J. Page is endeavoring to introduce incandescent electric lighting in the town of Welland, Ont.

According to Mr. John T. Grier, in the *Electrical Engineer*, of New York, "we may roundly define a dyne in language that will be more likely to stick to the memory and be more easily grasped by some if we slightly paraphrase the definition and say it is that force which, acting for one second on a mass of matter equal in weight to four-tenths of a dime, gives to it a velocity of almost four-tenths of an inch per second."

PATENTS

Obtained in Canada, United States, Great Britain and all Foreign Countries.

TRADE MARKS, DESIGNS AND COPYRIGHTS REGISTERED.

Examinations and Reports as to validity. Searches made. Infringements investigated. Assignments and Agreements drawn. Advice on Patent Laws, etc. Special Counsellors in Patent Causes.

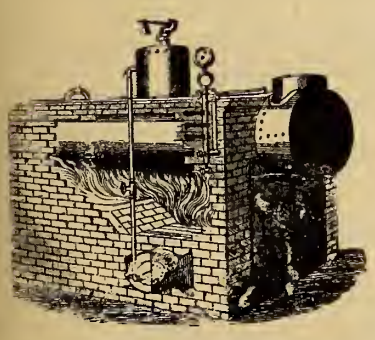
FETHERSTONHAUGH & CO.

PATENT BARRISTERS AND SOLICITORS,
ELECTRICAL AND MECHANICAL EXPERTS AND DRAUGHTSMEN,

Canadian Bank of Commerce Building, (Second Floor) - ***TORONTO.***

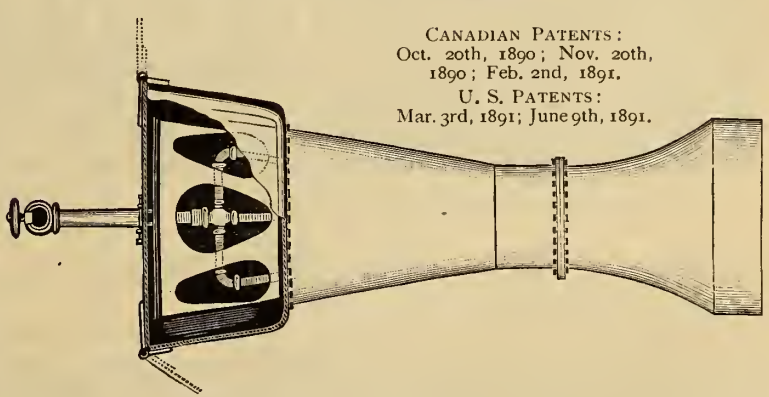
EARLE'S AIR AND STEAM INJECTORS

FOR PERFECT COMBUSTION OF FUEL IN FURNACES AND ABATING SMOKE.



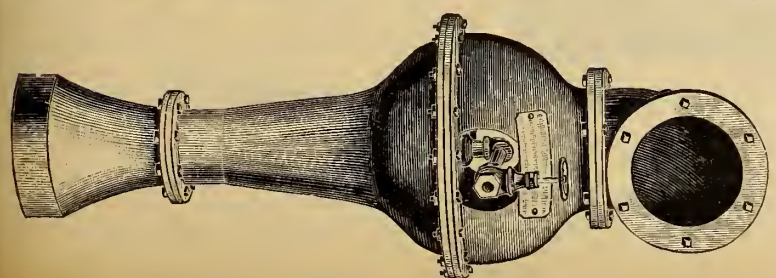
FOR
Stationary,
Marine,
AND
Locomotive
Boilers
AND
Producer
Gas Cupolas

Will burn successfully hard and soft coal screenings, tan bark, sawdust, coke screenings, cannel-coke, etc.



CANADIAN PATENTS:
Oct. 20th, 1890; Nov. 20th, 1890; Feb. 2nd, 1891.
U. S. PATENTS:
Mar. 3rd, 1891; June 9th, 1891.

AIR INJECTOR.



COMBINED AIR INJECTOR AND EXHAUSTER.

Thoroughly tested and found to work more satisfactorily than the best fan.

Circulars with testimonials on application.

MANUFACTURED AND FOR SALE BY

S. .R EARLE

Belleville, - Ont.

SPARKS.

All engineers will soon require as much knowledge of electricity as of mechanics.

The city of Winnipeg possesses a telephone exchange which has now 750 subscribers, being about one to every 36 of the population.

It is an acknowledged fact that the change from horse power to electric power increases the travel on street car lines. This is a very pretty compliment to electricity.—*Elec. Review, N. Y.*

Electric light has been employed advantageously on board a West Indian steamer crossing the ocean to keep alive and flourishing certain plants which were being transported for acclimatization.

The Association of the Edison Illuminating Companies has accepted the invitation of Mr. Nicholls, Manager of the Toronto Incandescent Electric Light Co., to hold a convention in Toronto next year.

Now that the electric shoe polisher has entered the field, the dirty-faced, but bright-minded little boot-black who for years has adorned the street corners, must qualify himself to earn a living in another way.

Prof. Elihu Thomson corrects the popular impression that luminosity of arc lamps is due to heated carbon particles. He says that, although there is a steady stream of carbon vapor between the carbons, yet the light is nearly all derived from the enormously heated surfaces from which the evaporation takes place.

The Executive Committee of the National Electric Light Association of the United States, at its last meeting unanimously adopted a resolution of thanks to Mr. John Carroll, manager of the Eugene Phillips Electrical Works, Montreal, for the unremitting and eminently successful efforts put forth by him on behalf of the visitors to the recent convention in Montreal. The resolution was ordered to be engrossed and presented to Mr. Carroll. No one will deny that the recognition is well deserved and timely.

The following lead alloy for accumulator plates is proposed by a M. Worms. It consists of 945 parts of lead, 22 of antimony, and 13 of mercury. The lead is melted first, and the antimony added, the mercury being introduced as the molten mass is run into the mould. The result is said to be an alloy of lead which can be easily split up into comparatively thin sheets.

Referring to the new Ottawa electric railway, the *Electrical Age* says: It is quite a point, too, in favor of electric railroads to have one in the capital city of the Dominion, where the legislators and chief officials can study its advantages. With these gentlemen on the side of electricity for motive power on street railways a great advantage will be gained. Their voices will be heard in connection with other similar projects, and if they believe in the new power, as they undoubtedly will when they become thoroughly familiar with it, capitalists will find it much easier to carry forward their plans than they would if they were required to argue and fight for every point involved when trying to obtain necessary legislation. It is hard work at best to get an electric road established, and it requires good generalship; but when the authorities understand for themselves what electric roads are and what they are good for, we claim that it is a big advantage gained.

The electric and gas lighting companies at Woodstock, Ont., will, it is said, amalgamate.

The Edison Electrical Diamond Drill and Prospecting Company will place a complete plant in the Sudbury district for the purpose of prospecting and developing properties.

ROGERS' DYNAMO OIL

Guaranteed Superior Quality and Economical.

SAMUEL ROGERS & CO.,

30 FRONT ST. EAST, TORONTO

MANUFACTURERS OF

Finest Engine, Cylinder and other Oils

THE SMITH PREMIER TYPEWRITER,
THE EDISON PHONOGRAPH,
AND THEIR SUPPLIES.
DESKS AND CABINETS.

HOLLAND BROS. & YOUNG,
1740 NOTRE DAME ST., - MONTREAL.

Electric Light Supplies

Covered Wire, Insulators, Cleats, Soldering Salts, Tape, Cut-outs, Switches, Sockets, and Shades.

Alternating and Direct Current Dynamos, Converters, and Meters. Repairs prompt and reasonable.

TORONTO ELECTRICAL WORKS

35 Adelaide Street West, - - TORONTO.

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B. & C. MAKE A SPECIALTY OF FINE CATALOGUE PRINTING

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Our FRICTION GRIP PULLEYS

ARE THE ONLY SPLIT GRIP PULLEYS & CUT OFF COUPLINGS MADE. GIVE EVERY SATISFACTION AS DRIVERS OR DRIVEN PULLEYS. FULLY GUARANTEED.

WATEROUS ENGINE WORKS CO.
BRANTFORD, CANADA.

OVER 100

IN OPERATION,

From 10 inches by 3 inches

— TO —

93 inches by 23 inches.

Giving perfect satisfaction.

USED BY

Hunt Bros. Electric Light Works, - London.
Royal Electric Light Co., - - Montreal.
Windsor & Sandwich Electric R. R. Co., - Windsor.

LINK BELTING Gives the advantage of a belt with the positive motion of gears. No centers too short for its use.

A paper manufacturer said to us: "I am using 88 in. to drive my lower floor, including my paper machine. Its positive motion, never varying, produces a ton of paper more every day. Every slip of the belt, or stoppage, means a loss of 100 feet of paper, and this never occurs now."

SPECIALLY ADAPTED FOR CONVEYING AND ELEVATING ALL KINDS OF MATERIAL.

SPARKS.

The town of Virden, Man., is to have the electric light.

The citizens of Waterloo are opposing the erection of electric light poles on the streets.

The Bell Telephone Co. are removing their wires to their new building in Hamilton, Ont.

The drills and hoists in the Templeton phosphate mines are to be worked by an electric plant.

During the Ottawa Exhibition, the Ottawa electric railway carried upwards of 100,000 passengers.

An incandescent lighting plant has recently been installed at Morden, Man., by Simson & Davis, of Winnipeg.

Messrs. John Inglis & Sons, Toronto, are constructing the engines and boilers for the new electric light works at New Westminster, B. C.

The St. Thomas Edison Electric Co., (Ltd.,) has recently been organized at St. Thomas, Ont., with a capital of $25,000, with the object of installing in that city a 1,000 light Edison incandescent plant. Among the leading stockholderers are Judge Hughes, G. R. Rennington, Frank Hunt and N. McDonald.

It is said that the experiment of the telephonic church service has proved so successful in Birmingham. Eng., that it is now proposed to develop the idea by connecting the hospitals of the locality to Christ Church, the centre of the experiment. Already the wire has been switched onto the bedrooms of sick folk, and with marked success—a flexible cord being attached to the ordinary receiver with a specially adapted instrument for fixing on the head of the invalid.

For the purpose of increasing the power of vibration in the telephone, Mr. Oscar Pohlmann, of Nuremberg, inserts a microphonic relay in the circuit. The disc of this relay has on one side a very thin layer [illegible] facing an electro-magnet, and on the other a microphone. In consequence the waves of the current the electro-magnet causes the disc to vibrate; and, as a result, the microphone begins to move. The relay should be placed in a void or a space in which the air has been rarefied. The suppression of the air diminishes the resistance to be overcome hy the disc, and its vibrations are extended or amplified, and the undulations of the current are thus reinforced. This apparatus will be found of advantage in long-distance transmission, according to the *Revue Scientifique*.

F. E. Dixon & Co.

MANUFACTURERS OF

LEATHER BELTING

70 KING STREET EAST, TORONTO.

HEADQUARTERS FOR

ELECTRIC LIGHT AND DYNAMO BELTING.

We have the following Leather Belts in use in the works of the Toronto Electric Light Co. :—

One 36 inch belt 98 feet long.
One 36 inch belt 100 feet long.
One 36 inch belt 123 feet long.
One 38 inch belt 100 feet long.
One 24 inch belt 100 feet long.
And over 1500 feet of 8 inch belting.

All of the above belts are DOUBLE THICKNESS. The 38 inch belt is the largest belt ever made in this Province.

We are prepared to furnish belts of any size, two or three ply up to 48 inches wide. Every belt fully guaranteed.

SEND FOR DISCOUNTS.

Book mailed free on application.

Dixon's Belting Hand-book

WHEN TO STOP ADVERTISING.

An English trade journal once requested a number of its largest advertisers to give their opinion concerning the best time to stop advertising, and the following replies were received :

"When population ceases to multiply and the generations that crowd on after you, and never heard of you, stop coming on."

"When you have convinced everybody whose life will touch yours that you have better goods and lower prices than they can ever get anywhere else."

"When you perceive it to be the rule that men who never advertise are outstripping their neighbors in the same line of business."

"When men stop making fortunes right in your very sight solely through the discreet use of this mighty agent."

"When you can forget the words of the shrewdest and most successful business men concerning the main cause of their prosperity."

"When every man has become so thoroughly a creature of habit that he will certainly buy this year where he bought last year."

"When younger and fresher houses in your line cease starting up and using the newspapers in telling the people how much better they can do for them than you can."

"When you would rather have your own way and fail, than take advice and win."

"When [illegible] else thinks 'it pays to advertise.'"

INCANDESCENT DYNAMOS

FOR SALE CHEAP.

HAVING a large assortment of the well known "Lahmeyer" Direct Current Incandescent Dynamos, Compound Wound, on hand, which we want to reduce, we will sell same at greatly reduced prices for a short time.

These Dynamos are equal, and in some respects superior, to any made. They are thoroughly well made both electrically and mechanically, of best materials and finish, and are the only Dynamos in the world which are cast in one piece.

They are especially adapted for factory and private use on account of their simplicity and minimum care required; the field magnets being inside of frame are protected from external injury. They are all compound wound, and owing to the large wire in the fields will not burn out.

The first "Lahmeyer" Dynamo started in Canada, over two years ago, has been working constantly ever since without costing the owners, Henderson & Potts, Halifax, one cent for repairs of any kind or giving a moment's trouble, notwithstanding the fact that it has been working on 80% overload, viz., 30 light machine running 55 lights.

EVERY MACHINE GUARANTEED.

Illustrated Circular and Price List sent on application to

JOHN STARR

GENERAL CANADIAN AGENT FOR

"Lahmeyer" Electric Light System. *"Unique" Telephones.*

"Samson" Batteries.

AND DEALER IN ELECTRICAL APPARATUS AND SUPPLIES.

HALIFAX, N. S.

Now is the time to equip your factory preparatory to the fall and winter months.

FIRSTBROOK BROS.

King St. East, - TORONTO.

MANUFACTURERS OF

Toppins,

Side-Blocks

—AND—

Cross-Arms

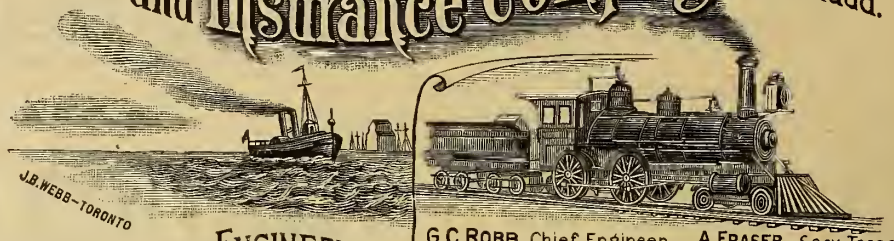
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Please mention the ELECTRICAL NEWS when corresponding with advertisers.

SUBSCRIBED CAPITAL, $100,100.
AMOUNT ON DEPOSIT WITH THE GOVERNMENT OF CANADA, $54,724.

THE BOILER INSPECTION and Insurance Company of Canada.

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JOHN L. BLAIKIE ESQ. VICE PRES.



J.B. WEBB—TORONTO

CONSULTING ENGINEERS.

G.C. ROBB. Chief Engineer. A. FRASER. Secy. Treas.

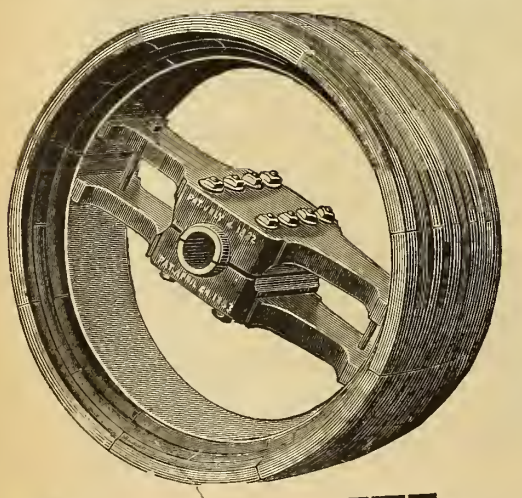
HEAD OFFICE. 2 TORONTO ST. TORONTO.

Prevention of Accident our chief aim. Economy of fuel secured.

NOTE—The offices of the Company have been removed from above address to the Canada Life Building.

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PULLEYS

OF EVERY DESCRIPTION.

Our Iron Centre with Maple Rim Pulleys are made specially for high speeds, combining GREATEST STRENGTH AND BEST BELT SURFACE, with lightness in weight and perfect running.

Send for Catalogue and Discounts.

Dodge Wood Split Pulley Co.

TORONTO. City Office: 83 King ... MONTREAL.

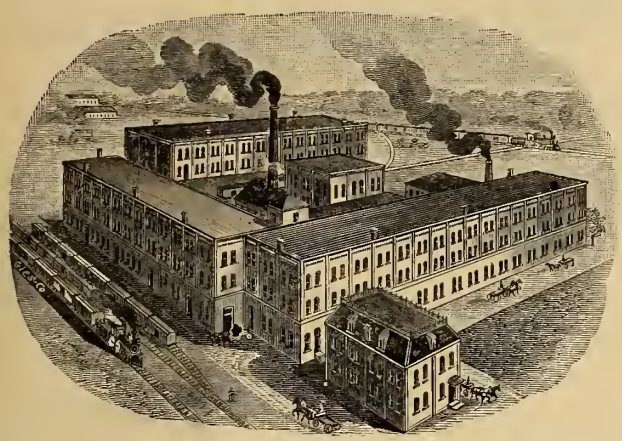
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WORKS AT FORT WAYNE, IND.

References in Canada:

Halifax Gas & Electric Light Co., Halifax, N.S.

New Glasgow, Nova Scotia.

The New Brunswick Electric Light & Power Co., St. John, N.B.

Electric Light & Power Co., Woodstock, Ont.

W. H. Comstock, Brockville, Ont.

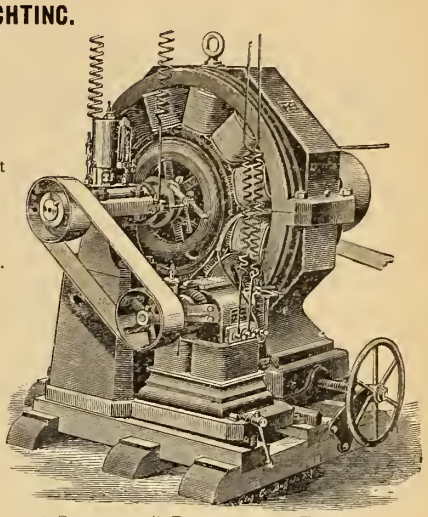
Electric Light & Power Co., Port Hope, Ont.

Electric Light & Power Co., Cobourg, Ont.

Corporation of Collingwood, Collingwood, Ont.

Niagara Falls Electric Light & Power Co., Niagara Falls, Ont.

Kingston Electric Light Co., Kingston, Ont.



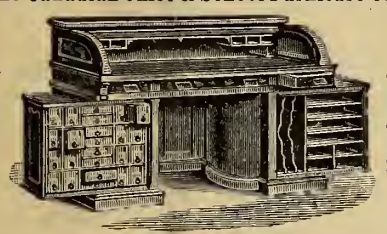
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NEW & 2ND ILLUSTRATED CATALOGUE FREE MACHINERY H.W. PETRIE TORONTO, CANADA

The Canadian Office & School Furniture Co.

PRESTON,  ONTARIO.

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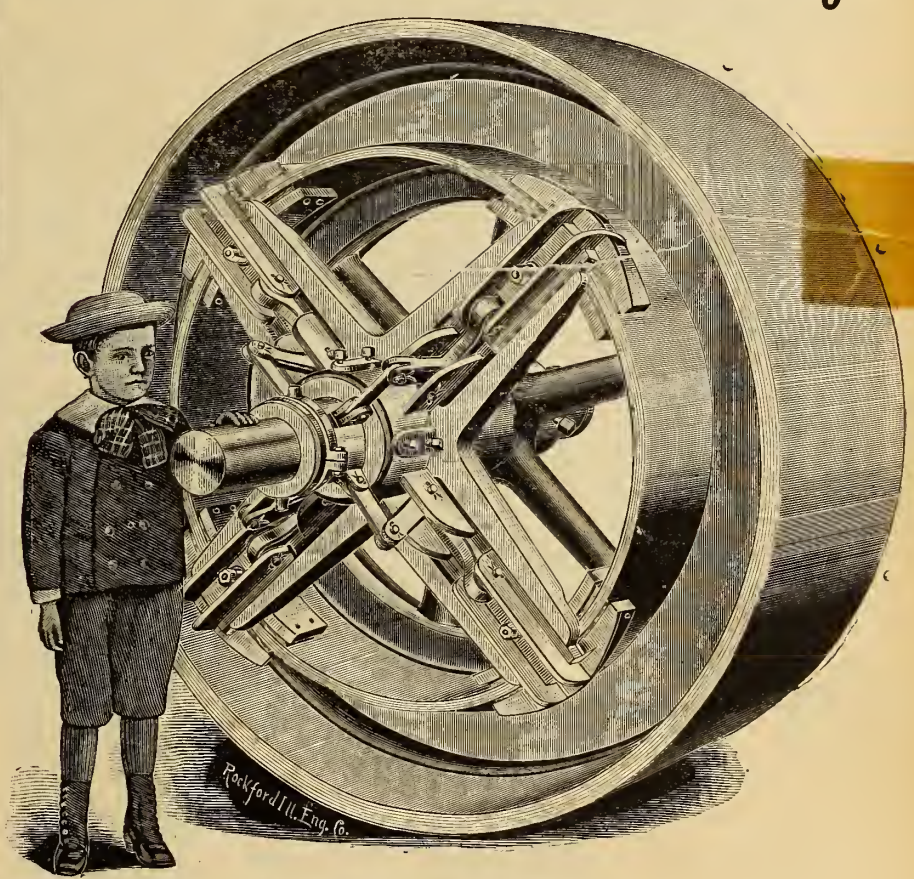
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CANADIAN ASSOCIATION STATIONARY ENGINEERS.

A. E. EDKINS, President, care T. Eaton & Co., Toronto.

JAS. ROBERTSON, Secretary Montreal Branch, 1420 Mignonne Street, Montreal.

Hill Patent Friction Pulleys



AND CUT OFF COUPLINGS

For Electric Light Stations and all purposes where intermittent power is required.

MILLER BROS. & TOMS,

(Successors to Miller Bros. & Mitchell)

Toronto Office: 74 York Street. MONTREAL, QUE.

ESTABLISHED 1869.

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TORONTO, - ONT.

MANUFACTURERS.

SHEET STEEL

OFFICE OF

THOMSON-HOUSTON INTERNATIONAL ELECTRIC COMPANY,

BOSTON, MASS.

BOSTON, November 2, 1891.

DEAR SIR:

We beg to inform you that we have appointed the **TORONTO CONSTRUCTION & ELECTRICAL SUPPLY COMPANY, LIMITED,** of Toronto, Ontario, our exclusive selling agents for the Dominion of Canada.

The Toronto Company have their main offices and show rooms at 63-69 Front Street, Toronto, where may be seen a specimen line of our apparatus, consisting of Dynamos for Arc Lighting of the celebrated WOOD SYSTEM, which we exclusively control for the Canadian territory, Dynamos and Transformers for Alternating-Current Lighting, Dynamos for Direct-Current Lighting, Reciprocating Rock Drills, Pumps, and other Mining Machinery, the Thomson Recording Watt Meter, now extensively used on the circuits of all Systems of Lighting and Power, and also a full line of the supply material manufactured or dealt in by this Company.

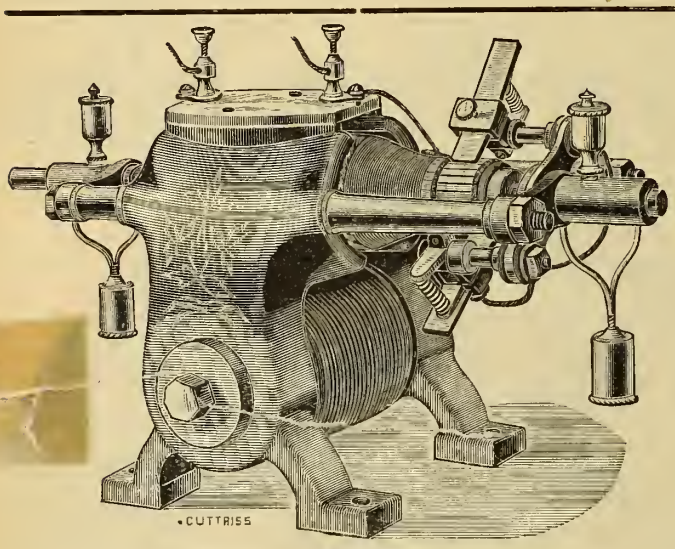
In referring you to the Toronto Company, we can assure you at their hands most courteous treatment and the fullest attention to your requirements.

They will have a competent corps of engineers in their employ thoroughly conversant with our Systems, and will be prepared to make studies and undertake engineering work for central station or isolated lighting, street railways, and mining work.

Thanking you for the courtesies we have received at your hands in the past, and bespeaking the same for our new representatives in the future, we remain,

Yours faithfully,

THOMSON-HOUSTON INTERNATIONAL ELECTRIC CO.



KAY ELECTRIC WORKS

NO. 263 JAMES ST. N. - HAMILTON, ONT.

MANUFACTURERS OF

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For Arc and Incandescent Lighting.

MOTORS

From 1-8 H. P. to 50 H. P.

ELECTRO PLATING MACHINES AND GENERAL ELECTRICAL APPLIANCES. SPECIAL ATTENTION TO MILL AND FACTORY LIGHTING.

WRITE FOR CIRCULARS.

A. W. BRICE & CO.

ELECTRICAL MACHINISTS,

MANUFACTURERS OF

Dynamos,

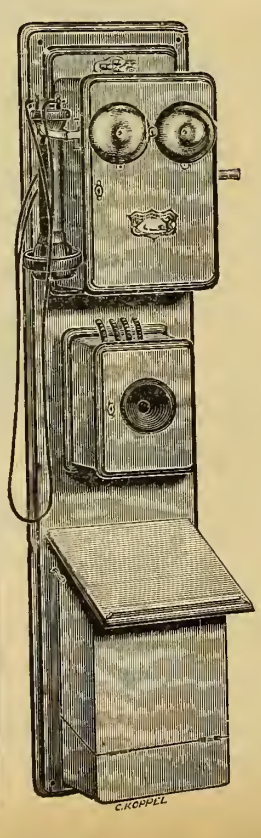
Motors,

And other Electrical Apparatus.

OFFICE AND WORKS:

20 JOHN ST. NORTH,

- HAMILTON.



TELEPHONES.

WE manufacture, for both main and private lines, first class thoroughly reliable telephones, equal to the genuine "Bell," and sell them outright at reasonable prices.

We contract to furnish Complete Exchanges, Telephone Instruments, Switchboards, Wire, Side Brackets, Insulators, &c.

Correspondence solicited from towns contemplating starting a telephone system, or parties intending putting up private lines.

T. W. NESS,

644 Craig Street, - MONTREAL.

CANADIAN HEADQUARTERS FOR

ELECTRICAL SUPPLIES.

Dynamos, Motors, Magneto Testing Bells, Incandescent Lamps, Sockets, Cut-outs, &c.

Our T.W.N. "Swiss" Incandescent Lamp gives satisfaction.

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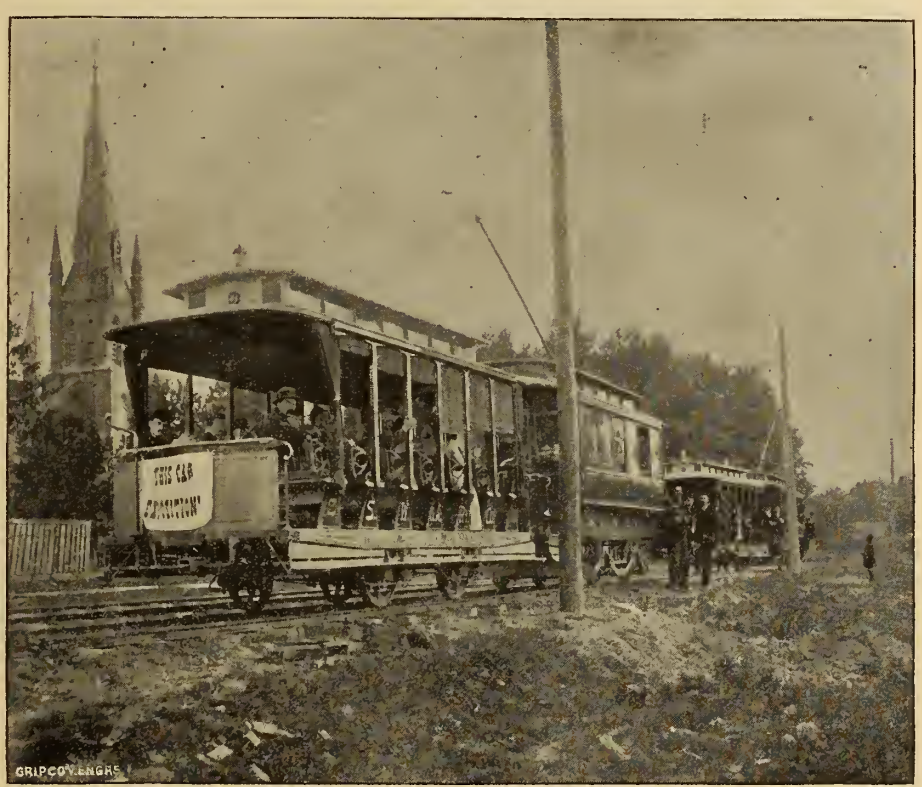
VOL. I. TORONTO AND MONTREAL, CANADA, DECEMBER, 1891. NO. 12.

THE WINDSOR AND SANDWICH ELECTRIC RAILWAY.

IN a recent issue of the ELECTRICAL NEWS brief reference was made to the completion of the above enterprise. By the courtesy of the manager, Mr. Willis C. Turner, we are now enabled to present to our readers a description and illustrations of the road.

The company consists of Mr. James M. Clarke, president; Carl. E. Warner, secretary-treasurer; Willis C. Turner, superintendent of construction and manager.

The company was organized as above, and the construction of the Sandwich branch commenced on May 1st of the present year. On August 17th the work on this branch was completed, and a satisfactory trial trip was made.



WINDSOR AND SANDWICH ELECTRIC RAILWAY.

The power house is situated on London street and adjacent to the Michigan Central Railway bridge. It is of brick and cut stone, with steel trussed supports and corrugated iron roof, erected at the cost of $12,000. Its dimensions are 147 x 50 feet, divided into two portions. The boiler room at the rear is on the level of the Michigan Central Railway, and connected therewith by a side track for the purpose of carrying coal for the use of the company. The main floor is occupied by the engines and dynamos, and is 80 x 50 feet, while the second story is used as a car storage room. This latter has four tracks 110 feet long, capable of holding ten cars. The steam plant is from the works of the Polson Iron Works Company, Toronto, Ont., and comprises two steel tubular boilers, 60 inches in diameter and 16 feet long, and one Crown automatic engine, 200 horse-power.

The Westinghouse Electric Company, of Pittsburg, Pa., supplied the electric plant used in operating the road. The dynamo is of 100 horse-power and capable of operating twelve cars. There are also eight 20 horse-power single reduction street railway motors, the gearing of which is sealed in a heavy iron case filled with a heavy grade of oil which prevents any noise and reduces the wearing of the gear to a minimum.

The present track consists of one and a quarter miles of fifty-two pound girder rails, and four and a half miles of thirty-five pound "T" rails, the whole constructed on heavy oak ties. The girder rails are used upon the paved streets, and by agreement with the council, as fast as the streets are paved the "T" rails are to be torn up and girder rails substituted. The road in operation to-day is the Sandwich branch and the extension to Wyandotte street. The Sandwich street and Dougall avenue loop and the Wyandotte street branch to Walkerville are not yet under way, although the franchises have been obtained. These portions will be pushed to completion with all possible speed.

The difficulty experienced by many roads in maintaining the contact between the trolley and the overhead wire, has been obviated by a new wire fixture invented by Mr. Turner. All connections with the overhead wire are planned by Mr. Turner and made in Walkerville. For the overhead wire six miles of No. 0 hard drawn copper wire is used.

The rolling stock consists of six closed palace cars, two double motors, four single motors and four open cars, manufactured by the Laclede Car Company, St. Louis, and finished in natural cherry and linden. Each closed car is fitted up with cushioned seats, bevelled mirrors and electric lights. These latter are incandescent, and five in number, three being in the centre of the car and one at each end outside. There are also two oil lamps, should anything go wrong with the electric light. The company is constructing freight cars to operate between Sandwich and Windsor, and Walkerville and Windsor.

It is stated that since the new road commenced operations the traffic has doubled. The town of Amherstburg is negotiating with the company to build a similar road for that place, and connect it with the Windsor road by means of a steam railway. Another result is the formation of syndicates for the purpose of improving property along the river.

In short, the results are those which usually follow in the wake of electric traction. The company are worthy of the highest commendation for the enterprise and energy which they have displayed in connection with this undertaking. It is sincerely hoped that they will receive satisfactory reward, and that in many other towns and cities in Canada the electric street railway will be given the opportunity to prove its advantages.

TORONTO BRANCH NO. 1, C. A. S. E.

AT the last regular meeting, which was well attended, the president, Mr. A. E. Edkins, asked the members to accept his resignation owing to the fact that when he entered upon his duties with the Boiler Insurance & Inspection Co., about December 1st, he would necessarily be absent from the city much of the time. Many of them expressed a wish that the president would remain in office until the end of his present term. Finally the Association decided not to accept the resignation.

During the evening considerable discussion took place on the theory and weight of fly wheels, the number, size and strength of cylinder head studs for different diameters of cylinders, &c. A very profitable evening was spent, and when the meeting adjourned at 10:30 there were several questions in the box, which were left over until next meeting night.

Two propositions for membership were received.

EXCHANGE OF IDEAS, CERTIFICATES, ETC.

Editor CANADIAN ELECTRICAL NEWS.

DEAR SIR,—As a subscriber to the NEWS from its first issue, I take the liberty to say a few words in regard to the "Questions and Answers" column. I have seen with surprise how little it is made use of by engineers. Every day engineers meet with problems on which they require information; if they would only jot them down and send them to the NEWS, every engineer among your readers would be benefited as well as the one asking the questions. Every day engineers are looking for formulas which they cannot find. Most of us are unable to buy every book that comes out, and lack time to look around for what we need. The only way to secure it is to write to a mechanical paper such as the NEWS.



POWER HOUSE AND CAR STATION, WINDSOR AND SANDWICH ELECTRIC RAILWAY.

When we had no paper printed in the interest of engineering in Canada, engineers were wont to say that they did not care to write to journals on the other side, but would write if they had a paper published here. Now that we have such a paper, it is a shame that more interest is not taken in it. If every one would lend a hand to help to build up the paper, assist to make it of interest to all engineers, to widen its circulation and to fill its columns, we would have a paper that would be of inestimable value to us.

I would also like to say a few words, if I am not taking up too much of your valuable space, on the subject of certificates. The engineers have always been clamoring for a licence law, and now that we have one, and can get certificates, the men who did the most talking are the most backward in coming up for a certificate. Certainly we are not compelled to get a certificate, as the law is not compulsory, but that is all the more reason for getting one, as under such circumstances it is an honor to hold one.

I believe we will have a compulsory law in the near future. It is what we want and what the country needs, but if we do not take advantage of the law as it stands, it will never be made compulsory. Let every engineer go up for examination and get as good a certificate as he can and as good as he deserves; it will be better for us all in the near future.

Yours, in the interest of engineers,

E. J. P.

RESOLUTION OF CONDOLENCE.

43 Brant St., TORONTO, Nov. 24th, 1891.

Editor ELECTRICAL NEWS.

SIR,—At a regular meeting of Toronto No. 1, C.A.S.E., held Nov. 13th, the following resolutions were unanimously adopted:

"Whereas it has pleased an all wise Providence to remove from our midst, Sarah, beloved daughter of Brother F. Bills, therefore be it

"*Resolved*—that this Association tender its heartfelt sympathy to the bereaved father and mother in this their sad hour of affliction, and be it

"*Resolved*—that this resolution be spread on the minutes of this Association, and that a copy be sent to Brother and Mrs. Bills, and to the ELECTRICAL NEWS AND STEAM ENGINEERING JOURNAL.

W. G. BLACKGROVE,
J. A. WILLS,
G. MOORING. } Committee.

A GOOD SUGGESTION.

PERHAPS the following suggestion may be of use to some who have the care of water power. It is given to the *Wood-Worker* by Mr. Gardner Morse, Eaton, N. Y., who writes:

Something more than six years ago, I was aroused about midnight, by the announcement that the creek was very high, that it was raining furiously; a dam above had given way, and it would be impossible to save my dyke and dam. I found the water rising rapidly, and that every effort to stop the break in the dyke with stones, plank and sod had proved useless. A big washout seemed inevitable, and that great damage would be done to the village below. By one of those inspirations that will sometimes come in great emergencies, I remembered the plan pursued to protect the levee of the Mississippi. I hurried a man off for all the grain bags that could be found. These were rapidly filled with sand and piled upon the break and weak places. In an hour the danger was over and no great damage done.

Again: A few weeks ago I was making some repairs in my dam, and found great difficulty in holding back the water long enough to do the work. The sandbags were once more resorted to, and they made a cheap and effective coffer dam.

These hints may help someone on a dark, stormy night, where high water has almost got the mastery, and only the most prompt and vigilant measures will avert a catastrophe.

PERSONAL.

Mr. P. G. Leigh, manager of the Kingston Locomotive & Engine Co.'s works, was married on the 28th of Oct. to Miss Maud Wilson. Mr. Leigh and his bride spent their honeymoon in Boston.

Col. C. F. Size, of Montreal, President, and Mr. Chas. Brown, Superintendent of the Bell Telephone Co. of Canada, and Mr. W. J. Morrison, agent of the Fort Wayne Electric Co., were visitors to New York last month.

Kingston will have an all-night electric light service after January 1.

CANADIAN ELECTRICAL ASSOCIATION.

A MEETING of persons interested in the formation of a Canadian Electrical Association, to receive the report of the Committee on Organization appointed by the meeting held in September last, convened in the Auditorium building, Queen street west, Toronto, at 10.30 o'clock on Thursday, Nov. 26th.

The following persons were present :—

E. S. Edmonson, Electric Light Co., Oshawa, Ont.; W. A. Johnson, manager Ball Electric Light Co.; Frederic Nicholls, manager Toronto Incandescent E. L. Co., James Corbett, electrician, Hugh Neilson, J. Dunstan, Bell Telephone Co., John Galt, C.E., Hy. S. Thornberry, J. J. Wright, manager Toronto Electric Light Co., C. H. Mortimer, Toronto ; T. W. Whiting, John Yule, Guelph ; A. A. Wright, Renfrew ; H. O. Fisk, J. W. Taylor, manager Brooks Mfg. Co., Peterboro' ; D. Thomson, manager Electric Light & Power Co., Thos. H. Wadland, B. J. Throop, Bell Telephone Co., S. Douglas, Kay Electric Works, Hamilton ; H. Powell, Woodstock ; John Carroll, Sec.-Treas. Eugene Phillips Electrical Works, Montreal.

On motion Mr. J. J. Wright was called on to preside, and Mr. C. H. Mortimer to act as secretary.

Letters regretting their inability to be present and expressive of hearty sympathy with the objects of the meeting were read from Mr. W. G. Fraser, Petrolea ; Mr. Geo. J. Thomas, local manager Bell Telephone Co., Essex, Ont.; Mr. C. E. Harris, general manager Bell Telephone Co., Halifax, N. S.; Mr. H. Brown, manager St. Thomas Gas and Electric Light Co., and Mr. W. J. Gilmour, local manager Bell Telephone Co., Brockville, Ont.

The Chairman remarked that the first business would be consideration of the report of the Committee on Organization, which was accordingly read by the secretary.

The recommendations contained in the report are as follows :

"That this organization shall be named the 'Canadian Electrical Association.'

"That the object of this Association shall be to foster and encourage the science of electricity and promote the interests of those engaged in any electrical enterprise.

"That the Association consist of active and associate members, the former to include all persons actively engaged in electrical business, and who shall be entitled to vote at all meetings of the Association, and the latter those interested or actively engaged in any electrical pursuit, and who shall be entitled to attend all meetings except those of the executive, and take part in all discussions, but shall not be entitled to vote or be eligible to office.

"That honorary members may be elected by a two-thirds vote of the Association.

"That the officers shall consist of a president, 2 vice-presidents, secretary-treasurer, who may be one person, and an executive committee consisting of nine members, together with the president and vice-presidents, five of whom shall form a quorum.

"That the fees shall be, for active members, $5, associate members, $2, payable in advance.

"All officers and the executive committee shall be elected by ballot at the annual meeting of the Association, and shall hold office until the close of the meeting at which their successors are elected.

"Vacancies in offices shall be filled by the executive committee to cover the term until the next annual meeting of the Association.

"Todd's Parliamentary Practice shall be the governing parliamentary law of the Association in all cases not definitely provided for by its constitution or its own rules.

"Voting by proxy shall not be allowed at any meeting of the Association or at any of its committees, except for the purposes of the election of officers.

"Amendments to this constitution shall be offered in writing and shall be referred before being voted upon to a committee to be elected by the Association. A two-thirds vote of all active members present shall be necessary for their adoption.

"No amendment shall be voted upon by the Association at the convention in which it is introduced except by a two-thirds vote of active members present.

"Ten members of this Association shall be a quorum for the transaction of business."

It was decided that the report should be considered clause by clause.

The clauses defining the name and objects of the Association were adopted without discussion. A variety of opinions were, however, expressed concerning the recommendation to divide the membership into two classes, and also regarding the qualification for active and associate members.

Mr. Thomson moved that each company be entitled to one vote.

Mr. Dunstan, Mr. Neilson and others pointed out that the result of adopting this motion would be to place the Bell Telephone Co., and the G.N.W. and C.P.R. Telegraph Companies, so far as voting power was concerned, on a level with the smallest electric light company in the country.

The feeling of the meeting was adverse to the resolution. It was decided that the voting power should be vested in individuals only.

To remove the misunderstanding which appeared to exist in the minds of some regarding the qualification for active and associate members, it was pointed out by the chairman and secretary that any person who might choose could become an active member by paying the necessary fee. It was agreed that the Executive Committee should be delegated the duty of deciding to which class applicants for membership should belong.

Mr. Carroll raised the question as to the sufficiency of the proposed fees to meet the financial requirements of the Association. It was thought best, not to increase the fees, the desire being to found the organization on lines as broad and liberal as possible, in order that no barrier might be placed in the way of persons desiring to become members.

Mr. Neillson saw an objection to the name which had been selected for the society. He thought a "Canadian Electrical Association" should be composed of electricians. He feared that in this organization the business element might in time become predominant and electrical interests a secondary consideration. He suggested that it might be well to change the name to the "Business Men's Association."

Mr. Johnston in reply pointed out that the aim should be to take in and promote the interests of the electrical business in all its branches, and that if deemed advisable, the different branches could be represented in the Association by sections, as in the case of the Society of Civil Engineers and other institutions of similar character.

This view was concurred in by the majority of those present, who were of opinion that the Association would only be likely to prosper in proportion as it was designed to subserve and harmonize the various electrical interests.

The report of the Committee on Organization, with slight amendment, was adopted.

A code of by-laws was also adopted.

The election of officers was next proceeded with.

Mr. Nicholls moved that Mr. J. J. Wright be the president.

The chairman suggested the name of Mr. S. R. Parker, of Owen Sound, as being a person well adapted for the position. The opinion of the meeting was, however, that the interests of the Association would be best served for the present by the election of a resident of Toronto. The election of Mr. Wright was therefore made unanimous.

On motion of Mr. Carroll, Mr. Dunstan was elected first vice-president.

On motion of Mr. Thornberry, Mr. Carroll was elected second vice-president.

On motion of Mr. Dunstan, C. H. Mortimer was elected secretary-treasurer.

The following gentlemen were elected to compose the Executive Committee : Messrs. Wright, (Renfrew); Yule, Edmonson, Parker, A. B. Smith, Thomson, Johnson, Fisk, Waddell.

On motion of Mr. Dunstan, seconded by Mr. Carroll, it was resolved that all fees paid before 1st June, 1892, shall be in full to 31st May, 1893.

It was resolved on motion of Mr. Carroll, seconded by Mr. Thomson, that the first annual meeting of the Association shall be held in the city of Hamilton on the second Tuesday in June, the time and place to be fixed by the Executive Committee.

The meeting then adjourned.

The Executive Committee subsequently met, and disposed of some preliminary business.

Mr. N. W. Rolt, local manager of the Edison company, [illegible] Winnipeg, Man., has been transferred to the Toronto offices.

The Edmonton Electric Lighting & Power Co., Ltd., has been incorporated by letters patent to furnish the incandescent light in [illegible] N.W. T. Capital stock, $10,000, all subscribed. The company has contracted with the Royal Electric Co., of Montreal, to put in a [illegible] plant. The lights to be turned on Nov. 30th.

SAFE ELECTRIC WIRING.

THE following recommendations are contained in a report presented at the recent electrical convention in Montreal by the Committee appointed to consider safe methods of wiring and operation of electric light apparatus:—

ARC (SERIES) SYSTEMS.

INTERIOR CONDUCTORS.

ALL INTERIOR CONDUCTORS—Must be:

1. Where they enter buildings from outside terminal insulators to and through the walls covered with waterproof insulation, and must have drip loops outside, preferably slanting upward toward the inside and bushed with waterproof and non-combustible insulating tube.

2. Arranged to enter and leave the building through a double contact service switch, which will effectually close the main circuit and disconnect the interior wires when it is turned "off." The switch must be so constructed that it shall be automatic in its action, not stopping between points when started, and prevent an arc between the points under all circumstances; it must indicate on inspection whether the current be "on" or "off," and be mounted on a non-combustible base in a position where it can be kept free from moisture, and easy of access to police or firemen.

3. Always in plain sight, never covered, except in special cases where an armored tube may be necessary.

4. Covered in all cases with a waterproof non-combustible material that will adhere to the wire, not fray by friction, and bear a temperature of 150 degrees F. without softening.

5. In dry places, kept rigidly apart at least ten inches, except when covered (in addition to insulation)—by a waterproof, non-conducting and non-inflammable tubing which must be strong enough to protect the insulating covering from injury. Conductors thus placed may be run not less than three inches apart, and be fastened with staples, under which are placed mechanically rigid insulating strips or saddles of greater width than the metal of the staple, by which possibility of injury to the tube may be prevented.

6. In damp places, attached to glass or porcelain insulators, and separated ten inches or more.

7. When passing through walls, floors, timbers or partitions, treated as in central stations under like conditions.

LAMPS AND OTHER DEVICES.

ARC LAMPS—Must be in every case:

1. Carefully isolated from inflammable material.

2. Provided at all times with a glass globe surrounding the arc, securely fastened upon a closed base. No broken or cracked globes may be used.

3. Provided with a hand switch, also an automatic switch, that will shunt the current around the carbons should they fail to feed properly.

4. Provided with reliable stops to prevent carbons from falling out in case the clamps become loose.

5. Carefully insulated from the circuit in all their exposed parts.

6 Where inflammable material is near or under the lamps, provided with a wire netting around the globe and a spark-arrester above, to prevent escape of sparks, melted copper or carbon.

Incandescent lamps in series circuits, having a maximum potential of 350 volts or over, must be governed by the same rules as for arc lights, and each series lamp provided with a hand switch and automatic cut-out switch; when lights are in multiple series, such switches and cut-outs must not control less than a single group of lights. Electromagnetic devices for switches are not approved.

Under no circumstances will incandescent lamps on series circuits be allowed to be attached to gas fixtures.

INCANDESCENT (LOW PRESSURE) SYSTEMS.

300 volts or less.

OVERHEAD CONDUCTORS.

OUTSIDE OVERHEAD CONDUCTORS—Must be:

1. Erected in accordance with general rules for arc (series) circuit conductors.

2. Separated not less than six inches, where they enter buildings as service conductors, and be provided with a double pole fusible cut-out, as near as possible to the point of entrance to the building, and outside the walls when practicable.

UNDERGROUND CONDUCTORS.

UNDERGROUND CONDUCTORS—Must be:

1. Provided with suitable protecting devices at the ends of tube or conduit services inside the walls of buildings, as a guard against moisture and injury.

2. Terminated at a properly placed double pole house cut-out.

3. Of specially insulated conductors after leaving the tube or conduit, and separated by at least 10 inches, until the double pole cut-out is reached.

INSIDE WIRING.

Wire should be so placed that in the event of the failure or deterioration of their insulating covering the conductors will still remain insulated.

At the entrance of every building there shall be a double pole switch placed in the service conductors, whereby the current may be entirely cut off.

CONDUCTORS—Must not be:

1. Of sizes smaller than No. 16 B. & S., No. 18 B.W.G., or No. 3 E.S.G.

2. Lead or paraffine covered.

3. Covered with soft rubber tube.

4. Laid in moldings of any kind in damp places.

5. Laid in moldings with open grooves against the wall or ceiling.

6. Laid in moldings where less than half an inch of solid insulation is between parallel wire, and between wires and walls or ceilings.

CLEATWORK is not desirable, and cleats must *not* be used unless—

1. In a very dry place.

2. In a place perfectly open for inspection at any time

3. They are of porcelain, or well seasoned wood, filled, to prevent absorption of moisture.

4. They are so arranged that wires of opposite polarity, with a difference of potential of 150 volts or less, will be kept at least two and one-half inches apart, and that where a higher voltage is used, this distance be increased proportionately.

5. There is a backing provided, of wood at least half an inch thick, well seasoned and filled, to prevent absorption of moisture.

METAL STAPLES must never be used to fasten conductors unless—

1. Provided with an insulating sleeve or saddle rigidly attached to the metal of the staple, and having such strength and surface as to prevent mechanical injury to the insulation of the conductor.

2. Under conditions in which cleatwork would be acceptable or where driven into a molding specially adapted for open work.

SPECIAL WIRING.

Wherever conductors cross gas, water, or other metallic pipes, or any other conductors or conducting material (except arc light wires), they should be separated therefrom by some continuous non-conductor at least one inch. In crossing arc light wires the low-tension conductors must be placed at a distance of at least six inches. In wet places an air space must be left between conductors and pipes in crossing, and the former must be run in such a way that they cannot come in contact with the pipe accidentally. Wires should be run *over* all pipes upon which condensed moisture is likely to gather, or which by leakage might cause trouble on a circuit.

In breweries, stables, dye-houses, paper and pulp mills, or other buildings specially liable to moisture, all conductors, except where used for pendants, must be:

1. Separated at least six inches.

2. Carefully put up.

3. Supported by porcelain or glass insulators.

Moisture proof and non-inflammable tubing may be accepted in lieu of such construction.

No switches or fusible cut-outs will be allowed in such places.

INTERIOR CONDUITS—Must not be:

1. Combustible.

2. Of such material as will be injured or destroyed by plaster or cement, or of such material as will injure the insulation of the conductor, or construction that the insulation of the conductor will ultimately be injured or destroyed by the elements of the composition.

3. So constructed or placed that difficulty will be experienced in removing or replacing the conductors.

4. Subject to mechanical injury by saws, chisels or nails.

5. Supplied with a twin conductor in a single tube where a current of more than 10 ampères is expected.

6. Depended upon for insulation. The conductors must be covered with moisture proof material.

The object of a tube or conduit is to facilitate the insertion or extraction of the conductors, to protect them from mechanical injury and as far as possible from moisture.

Twin tube conductors must not be separated from each other by rubber or similar material, but by cotton or other readily carbonizable substance

Conductors passing through walls or ceilings must be encased in a suitable tubing, which must extend at least one inch beyond the finished surface until the mortar or other similar material be entirely dry, when the projection may be reduced to half an inch.

DOUBLE POLE SAFETY CUT-OUTS—Must be:

1. Placed where the overhead or underground conductors enter a building and join the inside wires.

2. Placed at every point where a change is made in the size of the wire (unless the cut-out in the larger wire will protect the smaller). This includes all flexible conductors. All such junctions must be in plain sight.

3. Constructed with bases of non-combustible and moisture proof material.

4. So constructed and placed that an arc cannot be maintained between the terminals by the fusing of the metal.

5. So placed that on any combination fixture, no group of lamps requiring a current of six ampères or more shall be ultimately dependent upon one cut-out.

6. Wherever used for more than six ampères (or where the plug or equivalent device is not used) equipped with fusible strips or wires provided with contact surfaces or tips of harder metal soldered or otherwise having perfect electrical connection with the fusible part of the strip.

SAFETY FUSES must be so proportioned to the conductors they are intended to protect that they will melt before the maximum safe carrying capacity of the wire is exceeded.

All fuses, where possible, must be stamped or otherwise marked with the number of ampères equal to the safe carrying capacity of the wire they protect.

All cut-out blocks when installed must be similarly marked.

The safe carrying capacity of a wire changes under different circumstances, being about 40 per cent. less when the wire is closed in a tube or piece of molding than where bare and exposed to the air, when the heat is rapidly radiated. It must be clearly understood that the size of the fuse depends upon the size of the smallest conductor it protects, and not upon the amount of current to be used on the circuit. Below is a table showing the safe carrying capacity of conductors of different sizes in Birmingham, Brown & Sharpe, and Edison gauges, which must be followed in the placing of interior conductors.

Brown & Sharpe.		Birmingham.		Edison Standard.	
Gauge No.	Amperes.	Gauge No.	Amperes.	Gauge No.	Amperes.
0000	175	0000	175	200	175
0 0	145	000	150	180	160
00	120	00	130	140	135
0	100	0	110	110	110
1	95	1	95	90	95
2	70	2	85	80	85
3	60	3	75	65	75
4	50	4	65	55	65
5	45	5	60	50	60
6	35	6	50	40	50
7	30	7	45	30	40
8	24	8	35	25	35
10	20	10	30	20	30
12	15	12	20	12	20
14	10	14	15	8	15
16	5	16	10	5	10
		18	5	3	5

SWITCHES—Must:

1. Be mounted on moisture proof and incombustible bases, such as slate or porcelain.

2. Be double pole when the circuits which they control are connected to fixtures attached to gas pipes, and when six ampères or more are to pass through them.

3. Have a firm and secure contact, must make and break readily, and not stick when motion has once been imparted by the handle.

4. Have carrying capacity sufficient to prevent heating above the surrounding atmosphere.

5. Be placed in dry accessible places, and be grouped as far as possible, being mounted, when practicable, upon slate or equally indestructible back boards.

MOTORS.—In wiring for motive power, the same precautions must be taken as with the current of the same volume and potential for lighting. The motor and resistance box must be protected by a double pole cut-out and controlled by a double pole switch.

ARC LIGHTS ON LOW POTENTIAL CIRCUITS—Must be:

1. Supplied by branch conductors not smaller than No. 12 B. & S. gauge.

2. Connected with main conductors only through double pole cut-outs.

3. Only furnished with such resistances or regulators as are enclosed in non-combustible material, such resistances being treated as sources of heat.

4. Supplied with globes protected as in the case of arc lights on high potential circuits.

FIXTURE WORK.

1. In all cases where conductors are concealed within or attached to

fixtures, the latter must be insulated from the gas pipe system of the building.

2. When wired outside, the conductors must be so secured as not to be cut or abraded by the pressure of the fastenings, or motion of the fixtures.

3. All conductors for fixture work must have a waterproof insulation that is durable and not easily abraded, and must not in any case be smaller than No. 16 B. & S., No. 18 B.W.G., or No. 3 E.S.G.

4. All burrs or fins must be removed before the conductors are drawn into a fixture.

5. The tendency to condensation within the pipes must be guarded against by sealing the upper end of the fixture.

6. No combination fixture in which the conductors are concealed in a space less than one-fourth inch between the inside pipe and the outside casing will be approved.

7. Each fixture must be tested for possible "contacts" between conductor and fixture, and for "short circuits," before the fixture is connected to its supply conductors.

8. The ceiling blocks of fixtures should be made of insulating material.

ELECTRIC GASLIGHTING.

Where electric gaslighting is to be used on the same fixture with the electric light:

1. No part of the gas piping or fixture shall he in electrical connection with the gaslighting circuit.

2. The wires used with the fixture must have a non-inflammable insulation, or where concealed between the pipe and shell of the fixture the insulation must be such as is required for fixture wiring for the electric light.

3. The whole installation must test free from "grounds."

4. The two installations must test perfectly free of connection with each other.

PENDANTS AND SOCKETS.

No portion of the lamp socket exposed to contact with outside objects must be allowed to come into electrical contact with either of the conductors.

CORD PENDANTS —Must be:

1. Made of conductors, each of which is composed of several strands insulated from the other conductor by a mechanical separator of carbonizable material, and both surrounded in damp places with a moisture proof and a non-inflammable layer.

2. Protected by insulated bushings where the cord enters the socket.

3. So suspended that the entire weight of the socket and lamp will be borne by knots above the point where the cord comes through the ceiling block or rosette, in order that the strain may be taken from the joints and binding screws. All sockets used for wire or cord pendants should have openings at least equal to one-quarter inch gas pipe size.

4. Allowed to sustain nothing heavier than a four-light cluster, and in such a case special provision should be made by an extra heavy cord or wire, as a mechanical reinforcement.

5. Equipped with keyless sockets as far as practicable, controlled by wall switches. In no case may a lamp giving more than fifty (50) candle power be placed in a key socket on a flexible pendant.

PRIMARY CONDUCTORS.

In those cases where it may not be possible to exclude the transformers and primary wires entirely from the building, the following precautions must be strictly observed:

1. The transformer must be located at a point as near as possible to that at which the primary wires enter the building.

2. Between these points the conductors must be heavily insulated with a coating of moisture proof material, and, in addition, must be so covered and protected that mechanical injury to them or contact with them shall be practically impossible.

3. The primary conductors, if within a building, must be furnished with a double pole switch, and also with an automatic double pole cut-out where the wires enter the building, or where they leave the main line, on the pole or in the conduit. These switches should, if possible, be enclosed in secure and fireproof boxes outside the building.

4. The primary conductors, when inside a building, must be kept apart at least 10 inches, and at the same distance from all other conducting bodies.

SECONDARY CONDUCTORS.

The conductors from the secondary coil of the transformer to the lamps or other translating devices must be installed according to the rules for "inside wiring" for "low potential systems."

MISCELLANEOUS.

1. The wiring in any building must test free from "grounds" before the current is turned on. This test may be made with a magnet bell that will ring through a resistance of 20,000 ohms, where currents of less than 250 volts are used.

5. No ground wires for lightning arresters may be attached to gas pipes within the building.

3. All conductors connecting with telephone, district messenger, burglar alarm, watch clock, electric time and other similar instruments must, if in any portion of their length they are liable to become crossed with circuits carrying currents for light or power, be provided near the point of entrance with some protective device which will operate to shunt the instruments in case of a dangerous rise of potential, and will open the circuit and arrest an abnormal current flow. Any conductor normally forming an innocuous circuit may become a source of fire hazard if crossed with another conductor through which it may become charged with a relatively high pressure.

PUBLICATIONS.

We are indebted to Mr. C. C. Shelley, publisher, 10 and 12 College Place, New York City, for a copy of a work entitled "Central Station Management and Finance," by H. A. Foster. The book is one which should prove of advantage to owners and superintendents of central stations.

We are advised that the tenth edition of "The Electrician" Electrical Trades Directory, corrected to January, 1892, is in course of preparation, and will be published early in the new year. Judging by previous editions, this directory will be one of great value. The Electrician Publishing Co., Salisbury Court, Fleet St., London, E.C., are the publishers.

The Auburn Woolen Co., of Peterboro', Ont., recently purchased from the Edison General Electric Co. a No. 8 direct current dynamo and other necessary appliances for supplying current to 275 sixteen c.p. lamps distributed throughout its mill. The lighting plant occupies a building 38 x 20 feet in size separated from the mill.

SPARKS.

St. Dunstan's Cathedral, Charlottetown, P. E. I., is now lighted with the incandescent light.

The Walkerville Malleable Iron Works have recently contracted for an Edison incandescent plant.

The electric street cars in process of construction for Port Arthur, Ont., will be warmed by electricity.

Incandescents are a comparatively modern invention, but arklights were in use at the time of the flood.—*Westborough Tribune.*

The magneto motive force equals the products of the number of spirals and the number of amperes of current multiplied by 1.257.

The Sherbrooke Gas and Water Co. have lately made arrangements to supply 300 incandescent lights to Bishop's College, Lennoxville.

A 100 h. p. engine and 50 light dynamo are being added to the plant of the Brandon Electric Light Co., making the capacity of the station 2,000 lights.

An ingenious device for protecting carbons and carbon rods from the effect of sleet and snow is made of galvanized sheet iron and japanned, and is strong enough to withstand a great deal of hard usage. At the bottom is an extension feature that permits the protector to be adjusted to almost any size of lamp.

In a note in the *Comptes Rendus* of September 14th, M. Paquelin describes an incandescent platinum light devised by him. The apparatus consists of a strip of platinum coiled on itself and placed in a platinum bowl with a hollow stem. A gaseous mixture of air and some hydrocarbon vapor is then introduced under pressure in suitable proportions. The mixture is set alight, the flame disappears, and the platinum strip incandences, the incandescence being the more intense the greater the pressure. With moderate pressures the light is comparable with that emitted by an electric lamp. The whole apparatus can be plunged into water without the light being extinguished.

The electric current has been used since 1889 at the small arms factory at Saint Etienne for annealing the steel wire of which the hammer springs of the rifle, 1886 pattern, are made. These springs are manufactured of steel wire, 7 millimetres thick, cut in lengths of 3.20 metres; the wire is rolled spirally and a current of 23 amperes is passed through it. Heating is rapidly effected; when it is judged sufficient, the circuit is opened, and the hammer-spring into a water tank. One man can anneal 20 springs in three minutes, equivalent to about 2,400 per day. Electric annealing being clean in operation, and cheap, will, no doubt, soon be applied in numerous cases analogous to the one indicated.

Albert Moyse, of Montmorency cotton mill, tells of a remarkable experience he recently had with a live electric wire. He was called one evening from the machine shop to the mill to look after some machinery which was out of order. He took a couple of men with him. "After I had been working a short time," he said, "it grew dark and I had to start the electric arc light. The light was nine feet from the floor and I stood on an iron machine to reach it. Before I touched it I asked one of the men if the motor power had been turned off He replied that it had. I then reached out my hand to catch hold of one of the conducting wires to steady myself. The weather at the time was very wet. As soon as I touched the wire with my right hand I felt myself drawn up with remarkable rapidity. Blue flames shot from my eyes. It was intensely blue, yet brilliant. I felt a sensation such as I never experienced before. As far as I could realize the feeling was pleasureable. I felt that my time had come, and I lost consciousness. I afterwards learned that this experience had not taken more than two seconds. Those who saw the accident said that as soon as my hand touched the wire I was dragged up like a flash, dashed bodily against the ceiling, four feet above the wire, and then thrown to the floor where I laid for over an hour unconscious. At the time I got the shock the power was running through the wire at the rate of 1,100 volts. The motor had not been turned off. When I came to my senses I was lying at the bottom of a cart and was being driven home. For over ten minutes I could not remember anything. The man who was driving was one of the mill hands, but I could not remember who he was. He said he spoke to me as did others in the cart, and that I answered back in a most foolish way. They thought I had lost my reason. I was taken to my home in this strange condition and for some time could not recognize my own wife and family. When I fully regained my senses, I began to sufter for the first time. All over my body came tingling, pricking sensations, which were very agonizing. Sparks would at intervals shoot from my eyes. My body was so sore that I could not bear my clothing, while my hair actually seemed to be electrified and to be raised from my scalp. I looked into a mirror and did not know myself, for my face was swollen to twice its natural size, while the skin had swollen so much on my forehead that it hung like a bag over my eyelids, almost preventing me from seeing. I was suffering very keenly. One of the men had gone to get Mr. Strachan, of the electric light company, to see if he could do anything for me. As soon as he saw me he took off my boots and socks and brought me into the yard, where he walked me barefooted over the damp earth. It was such a comfort as soon as my feet touched the earth. I could feel the electric fluid running through my body to my feet, and then into the earth. The cure was a speedy one and I soon felt relieved. I was sore for days after, though. The accident would not have taken place had I not been standing on an iron machine, which made a circuit through me. They said it was a miracle I had not been instantly killed."

mises.

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EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

SEND in your application for membership in the Canadian Electrical Association.

WITH the present number the ELECTRICAL NEWS closes its first volume. A properly classified index to the contents of this volume is herewith presented.

THE Commissioner of Patents recently made the statement that no action had been taken with the view of extending the life of the Bell telephone patents in Canada.

AS the festive season will have passed before the NEWS again reaches its readers, we embrace the present opportunity of wishing one and all a Merry Christmas and Happy New Year.

THE commendable recommendation is made by the Electric Commission for the District of Columbia that all high tension electric wires which may be regarded as dangerous to life, shall be painted red.

THE remarks of a correspondent printed in another column, on the value to engineers of an exchange of ideas through the Question and Answer department of this paper, are timely, and worthy of earnest consideration by the class to whom they are addressed.

THE outlook in electrical industries has never been so bright as at present. The large manufacturing concerns in Canada, such as the Edison and the Royal, are overwhelmed with orders, and are working night and day. They are still months behind. The demand for motors has been such that it is difficult to obtain them, and they have to be imported at increased cost from the other side. Engine builders also are very busy with orders for the supply of engines for electric installations. The business promises to be very brisk for some time to come.

THE *Evening News*, of Toronto, has recently been printing a series of articles advocating a closer trade relationship with the people of the mother country. They point out with considerable ability that unless we wish to drift into some undesirable position we must make our destiny ourselves. There is no doubt that by admitting English goods in return for a preference in their markets for our produce, we should encourage the influx of the most desirable class of immigration, the agricultural, and the Dominion be made independent of the markets now closed against us by the great American ———.

oth-
shoul- r appears that a receiver has been appointed for the St.
one li- -rines and Thorold Electric Railway. The action was taken on behalf of the bondholders, as it is claimed the railway has been running at a loss for the past six months. It is unfortunate that this should be the outcome of the enterprise of its projectors, as it was one of the first railroads in Canada to be continuously operated by electricity. As water power is used, it would seem strange that running between towns like St. Catharines, Merritton and Thorold, it could not be made to pay. The explanation, however, is, that being one of the pioneer electric roads on the continent, the apparatus used was of a more or less crude and imperfect construction and design, so that interruptions to traffic would be too frequent to be consistent with successful business. There is no doubt that if the road could be equipped with the modern motor and appliances it could be made a paying and profitable investment.

THE scheme for bringing water for Toronto use from Lake Simcoe will probably die the death of its aldermanic sponsors, and will be interred with their bones on the ides of January next. Apart from the fact that the quality of the water is much inferior to that at our doors—simply to be had for the pumping—the cost of the enterprise would considerably outweight its possible advantages. It is stated that the revenue for power supplied to manufacturers would be enormous. We have shown in a previous issue that the idea is fallacious. If the power is to be distributed hydrostatically to the different factories, new mains of immense size would have to be laid all over the city—if electrically, the loss in transmission, cost of maintenance of apparatus, and the *smallness of the available power* would put revenue out of the question. Especially would this be the case were the whole arrangement under municipal control. Then it is stated it would do away with the necessity for a trunk sewer, probably by using the present suction pipe as an outlet. Even if it were large enough it must be remembered that it could only be reached by means of a trunk sewer intercepting all the others. The power to be developed by the city water supply from Lake Simcoe, which would have to be developed miles outside the city in any event, is purely a figment of the imagination, and it is well that the citizens should have this fact impressed upon them before they determine to spend fifteen or twenty million dollars to get bad water.

THE manufacture of carbons has become an important branch of the electric light industry. It was not long ago that it was a little understood process, and the prices obtained were high, but of late years and owing to the largely increased demand, the number of factories has multiplied. An attempt was made a year or two ago to form a combine and raise the price to a fancy figure, but like all movements of the kind which are overdone, it collapsed, after bringing into existence a new factory started by a large manufacturing electric light company. The same process is in course of repetition again, but warned by former experience, it is being done quietly and carefully, so as not to alarm the consumer unduly. The price at present has not materially advanced and probably will not until the combine controls the whole of the factories. We have in Canada a thriving business of this kind upon which the "trust" have cast an envious and a longing eye. In fact, they make no secret of their intention to either buy or starve it out of existence. The remedy is plain, however, and is in the hands of the consumers themselves. They must stand by a Canadian institution, but if it fails, there are enough carbons used by two or three of the largest plants in Canada to amply justifiy the establishment of a co-operative factory to manufacture for their own use. Carbons have been made in Toronto years ago, and can be made again—in fact, some of the machinery used still remains intact, and could be brought into use on short notice. The moral of all this is, that if the combine tries for too much, like the dog in the fable, it will probably lose all.

IT is certain that we are upon the eve of great discoveries in the field of electrical science. The perfection to which electric lighting has attained, great as it is, is but the threshold as it were of the possibilities yet to be realized. When it is considered that of the amount of energy expended not one-tenth appears as light, leaving the larger proportion to take the form of heat, it is at once seen that absolute perfection is yet a long way off. Light without heat is the dream of the scientific

explorer in the realm of nature, and when it is successfully achieved our present wasteful methods will appear crude indeed. We are burning up our stoves as well as our fuel. We are like the Chinaman who invented cooked pig—we burn down our house to get roast pork. The experiments of Tesla with currents of high frequency are upon this line, and may yet take practical shape. If a medium of sufficient tenuity could be found capable of transmitting the almost inconceivably rapid vibrations of light as set in motion and maintained by the subtle force of electricity, the grosser form of caloric would be passed and left behind, and the cold and brilliant aurora glow of heatless light would be attained. But where is this medium to be found? The molecules of ordinary metals are incapable of being attuned to the rapidity required. Copper, our best conductor, would probably be too inert to transmit the vibratory force, and be dead as so much wood. But if it is accomplished, it will have this peculiarity—the electricity capable of producing a heatless light would have no effect upon the human organism. If a metal will oppose resistance to the rapidity of its vibrations, so in a much greater degree would the tissues of the human frame, and the possibility of injury be a thing of the past. Although the electric current may be weighed and measured with precision and appears to follow certain fixed laws, but little is known of its actual constitution, and in what manner it is transmitted along the most favorable path. But there are immense possibilities in it, and before long we may look for further discoveries in its application to the production of light.

WE have great pleasure in being able to record a most successful inaugural meeting of the Canadian Electrical Association. Representatives of every branch of electrical science and from all parts of the Province were present, while from the most distant parts of the Dominion came letters of good will and hearty accord with the objects of the Association. Organization and the formulation and adoption of the necessary constitution and by-laws necessarily took up a large part of the time together with the appointment of officers and executive to act until the first annual meeting to be held in Hamilton next June. The adoption of our neighbor city as the place of congress we look upon as being particularly felicitous. It is as accessible as any from all points of the compass, and has a special reputation for doing up affairs of this kind in the most approved and hospitable manner. From the well-known characteristics of its representatives on the Executive we have the most unbounded faith, amounting to a certainty, that this well-earned reputation will in no wise be allowed to suffer. There will be important questions to be discussed from commercial as well as scientific standpoints with probably a dash of the legislative thrown in, and possibly the relation of electrical interests to the municipalities with whom they all, more or less, hold close relationship. From a technical standpoint the development of electrical art is so rapid that between now and the date arranged there may be a good deal that is new to bring forward. It is also our idea that it might be a feasible plan to arrange or appoint a Board of Arbitration to whom disputed questions or questions of interference might be referred for amicable settlement. In short the sphere of usefulness of the newly inaugurated Association appears to us to be almost boundless, and we predict that, under wise and skilful management, it will assume a position both of importance and influence. Let the Association be national in character as well as in name, and while maintaining feelings of the utmost friendliness to the nation to the south of us, demonstrate that, favored as we are by nature, by position, and by connection with that greatest of empires on some part of which the sun forever shines, for skill, enterprise, invention and manufactures, we are able to hold our own without dependence and even attain supremacy among the nations of the earth.

THERE is a demand arising for a better class of work in the installation of wiring and machinery by electric light companies. The business has passed very largely beyond the experimental stage, and when electric light apparatus is put in it is intended to be a permanency. In the early days of the art, before the necessity of thorough insulation was understood, work more or less crude was done, but this has been largely replaced. Impatience has also been largely responsible for temporary and slip-shod work. An electric plant has been decided on for a town or a factory after much delay and figuring, and then the contractor is hurried to get at least some of the lights in operation at the earliest moment. Wires are strung in a faulty manner, not sufficiently fastened, or care taken to insulate from the ground, with the intention of coming back to it to make it right. But it is neglected or forgotten, until a forcible reminder in the way of an incipient fire brings it home in an unpleasant manner. Wiring work for electric lights should be done with the greatest care and in a permanent manner, and should be so done that where near pipes or other ground a contact is impossible ; and furthermore, the wiring should be secured against any possible injury from contact with men and tools that are continually on the move about a factory or workshop. Also, instead of it being the ambition of the wireman to get his loop to a predetermined spot with as little trouble to himself as possible as long as he gets there, it should be run in a mechanical manner in mathematically straight lines and thoroughly secured—no kinks or curls or loose bights of wire such as have to be twisted around the nearest nail or tied up with twine to keep them out of the way. With regard to pole lines and outside construction, it is often the case that a municipality will not give a contract for lights except for a short time, so that the contractor is not justified in doing permanent work, and in cases where there is no contract there is so much talk of compelling electric light companies to take their wires down and go underground, that first-class permanent work is an impossibility. If it was understood that the lines were not to be interfered with by legislative action, there would be such a class of neat, permanent and safe work done that legislative action would be unnecessary. The time for slip-shod, careless and slovenly work has at any rate gone by, and the individual or company who care to conserve their own interests will see that the best class of workmanship only is employed.

BELL TELEPHONE CO.'S IMPROVEMENTS.

THE Bell Telephone Company's new building on Temperance St., Toronto, is nearing completion. It will cost $50,000, and is designed when furnished to be one of the most complete exchanges on the continent. A representative of the company is now visiting the leading exchanges of the United States for the purpose of obtaining the information which will enable them to decide upon the best style of switchboard to adopt. After this important matter is decided, six months or so will be required for manufacturing and placing the switch-board in position, so that the removal to the new building will probably not take place for nearly a year. Provision will be made in the new exchange for 5,000 subscribers.

A large tunnel some seven or eight feet in depth, perfectly waterproof, and lighted by electricity, is being constructed on Temperance St. In this tunnel 125 ducts will enter, 60 from the west, and 66 from the east. Each of these ducts holds a cable two inches in diameter, and each cable has 100 wires, representing 50 subscribers.

NEWSPAPER ELECTRICAL MARVELS.

THE love of the marvelous which is ingrained in our poor human nature has been well fed in recent years by actual achievements in electricity, itself the greatest marvel of all, since we seem to be as far off as we ever were from comprehending the real nature of the "fluid." It has therefore become a most useful field for the wonder-mongers of the daily press to work in, since they have but scant sense of responsibility for the truth of their statements, while they have a strong and chronic desire to get a column or two of highly spiced food for the jaded palate of the Sunday reader. If only they can mix in a little truth and a little news with their marvels, so much the better, but the marvels must be had anyway, and there is hardly a week in which new ones, which only need to be true to be highly important, are spread at length before the public.—*Engineering News.*

The Boiler Inspection and Insurance Co. of Canada, gives notice of its intention to apply at the next session of the Parliament of Canada for an act to add to the powers of the company the right to insure against loss of humad life or injury to person or property arising from the use of elevators, hoists or lifts or machinery connected therewith, and machinery used for the production of electricity as a motive power or illuminating agent, and otherwise enlarging the character of the risks which the company may undertake, and for such other powers as may be necessary in the premises.

THE ELECTRIC TRANSMISSION OF POWER.*

By Gisbert Kapp.

The transmission of power, in whatever way it may be effected, is one of the most important problems in applied mechanics. Strictly speaking, it enters into and is, indeed, precedent to the application of power to all industrial operations. The power developed in a Lancashire mill-engine only becomes of value to the spinner or weaver after it has been transmitted to the mules or looms by the agency of ropes, belts, pulleys, and other gear. Without such gear affecting the transmission, the power developed by the local steam-engine would be as useless to the mill owner as the power which may be contained in a waterfall miles away. In either case transmission must precede the application of power, but whilst in the former case the problem of transmission is simple, and has to be attacked rather from the point of view of convenient subdivision, than with particular regard to efficiency (this being naturally high with properly designed gear), in the latter case the problem is of a much more difficult character, and efficiency, combined with moderate capital outlay, small working expenses, reliability, and safety become matters of first consideration.

We have thus to distinguish between two kinds of power transmission, the one taking place over distances reckoned by feet or yards, and the other over distances reckoned by thousands of feet, or even by miles. When we speak of the electric transmission of power, we tacidly assume that it belongs to the latter class, and refers to distances beyond the reach of the ordinary gear, such as shafting, cog-wheels, pulleys and belts, employed for the subdivision and distribution of power within the walls of a factory ; and it is in this generally accepted sense that I propose to bring the subject mainly before you. There are, however, cases where the application of electromotors to special tools is either the most convenient or only possible method of applying mechanical power to the performance of certain operations, and it will, therefore, be necessary, at least briefly, to glance at that part of our subject which is not usually comprised within the title of these lectures, namely, the transmission of power over very short distances by means of electric currents. We thus distinguish between "long distance" and "short distance" transmission, the fundamental distinction between the two being that, in the former, the transfer or transmission of power from one point to another, so to speak, in bulk, is our main object ; whilst in the latter we rather aim at the subdivision and convenient application of power, in small quantities, at various points, and for particular purposes. I propose to consider long distance transmission first.

Broadly speaking, there are two ways in which we can transmit mechanical energy from one place to another. Let us assume, by way of example, that the primary source of energy is coal, and that the power derivable from this coal is required, not at the pit's mouth, but at a mill a certain number of miles away. In such a case, the obvious, and also the most economical way of transmitting power is to carry the coal to the mill, and burn it under the boiler of the mill-engine. Even if the distance between the pit and the mill is short, this method will be the best, provided there are no difficulties of transport. Suppose, however, that, although the distance is short, local conditions, such as great difference of level, bad roads, or total absence of roads, render the carriage of coal difficult or impossible, then we would establish our boiler and engine at the pit, generate the power there, and transmit it by wire rope, or in some other way, to the mill. In both cases we have transmission of power, but the methods are essentially different. In the first case we have transmitted, not mechanical energy itself, but the thing from which mechanical energy can be obtained, namely, the coal, each ton of which represents so many stored horse-power hours. In the second case we have transmitted the energy itself in its kinetic or potential form. In popular language we might describe the process as the transmission of "live" power, as distinguished from the transmission of "stored" power, which takes place when we carry coal from the pit's mouth to the mill.

The most important sources of power in nature are corn, coal, and falling water. Under the term "corn" I comprise all vegetable food-stuffs suitable for conversion into mechanical energy, by means of horses and other animal engines ; whilst the term "coal" naturally includes all kinds of fuel suitable for conversion into mechanical energy by some form of heat-engine. The power derived from corn and coal is generally transmitted in the stored form ; that derived from falling water in the live form, since the conveyance of water at a high level, or under considerable pressure, to great distances, necessitates the erection of very costly works. To prevent misunderstanding, I must here point out that I use the term "stored energy," as applied to water, merely in its colloquial sense. We speak of the energy stored in the water of a mill-pond, but, in reality, the energy does not reside in the water at all, but is an effect of its elevated position, and is, therefore, not comparable with the energy which is chemically stored in coal. Leaving, however, such distinctions on one side at present, we may regard water, which is being carried along horizontally, at a certain elevation, from one place to another, as the vehicle of so much stored energy, which we can obtain, in its live form, at any point at which we establish a water-engine, through which the water passes in its descent to a lower level. If we carry water along in this way, it is not with the object of bringing the stored power to the point of application, but merely to secure the largest possible fall, and, therefore, a maximum of power with a given quantity of water. If it be necessary to transmit the power farther, the transmission is generally effected in the live form. Now let us see what position electricity occupies in relation to these primary sources of power in nature, namely, corn, coal, and falling water.

In the first place it will be obvious that, where electricity is the transmitting agent, we can effect the transmission both in the stored and in the live form. To see this clearly, we need only for a moment revert to our example of the coal pit and the mill. Instead of sending the coal to the mill to be converted into power there, we could burn it at the pit, and thereby generate steam to be used for driving a steam dynamo. The current from the dynamo we could utilize in charging a storage battery, and send this to the mill, where it would drive an electromotor, thus taking the place of the local steam engine. Here we have a system of transmitting energy in the stored form. On the other hand, if we do away with the batteries as a vehicle of energy, and connect the dynamo at the pit with the motor at the mill by a pair of insulated wires, we have a system of electric transmission of power in the live form. The latter system is that generally understood under the term "electric transmission of power," and therefore forms the principal subject of these lectures ; but before entering upon it, I propose briefly to investigate the capabilities of electric transmission of power in the stored form.

As you all know, a sack of coal contains more stored power than a secondary battery of equal weight, and its carriage, whether by rail or road, is cheaper, easier, and requires less precautions than that of the battery. It is, therefore, quite obvious that, if the primary source of power is coal, and if there is no objection to the establishment of a steam-engine at the place where the power is wanted, it will be more economical to carry the power there in the form of coal than in the form of batteries ; not only because of the saving in carriage, but also on account of the smaller capital outlay, the smaller depreciation, and the avoidance of the loss of energy in the battery itself. But let us assume that the primary source of energy is falling water, then it is not so obvious at the first glance that its electric transmission in the stored form should be uneconomical. We cannot produce coal out of the energy of falling water, but we can charge batteries with it, and electricity would thus seem to offer a means of utilizing a power of nature which would otherwise be lost. It might, perhaps, here be objected that electricity does not form the only means for utilizing such a power, since there are various other ways in which power may be stored, a familiar example being compressed air. We might, therefore, also utilize the power of the waterfall for working an air compressor, and store the air under pressure in steel reservoirs, to be used afterwards for working air-engines constructed similarly to ordinary steam-engines. Many such engines are actually in use in Paris on the Popp system, though there the air is conveyed to them by pipes under pressure, and not in storage vessels, as would be the case in our example. There can thus be no doubt that the transmission of power by stored air is practicable, but the question is, at what cost will it be effected, and can it compete with transmission by batteries? The answer to these questions depends on two factors, namely, the storage efficiency and the cost of transport. By storage efficiency, I mean the ratio of the power put into and taken out of the apparatus which serves as the vehicle for the power. Batteries may now be obtained in which this ratio is about 80 per cent.; that is to say, for every 100 h. p. hours put into the battery, 80 h. p. hours can be taken out. The storage efficiency of compressed air is very much smaller. The most reliable data under this head are to be obtained from the Paper which Prof. Kennedy read before the British Association in 1889, when he gave an account of experiments carried out at Paris on the Popp system. He found that the indicated efficiency with cold air was 39 per cent.; that is to say, for every 100 h. p. indicated by the compressing-engine, 39 h. p. were indicated in the engine driven by compressed air as it came from the mains. If the air before being admitted to the engine was heated to 320° F., the apparent indicated efficiency rose to 54 per cent., but as the heat energy thus supplied to the air requires the expenditure of fuel at the point where the power is wanted, the use of hot air really involves two methods of transmission—namely, that of power in the shape of air under pressure flowing through the mains, and that of power in the stored form contained in the fuel. To make the comparison with electric transmission of stored power a fair one, I must therefore take the efficiency of the Popp system when the air is not heated. A correction must, however, be made for loss of power in the mains. In the Popp system the power is transmitted in the live form by air flowing through pipes, and there is necessarily a certain loss on account of friction in the pipes and valves. As far as the friction in the pipes is concerned, this would not occur if the transmission were effected in the stored form by means of air carried under pressure in a reservoir, but, on the other hand, the loss by friction through valves would be greater, because it would be necessary to insert between the reservoir and the air-engine a reducing valve, which would regulate the supply of air as the pressure falls. The loss of power due to this circumstance will probably be greater than the cor

* Cantor Lecture I, delivered before the Society of Arts, February 16, 1891.

responding loss in the Popp system, where the pressure is constant; but as I have no experimental data to determine this point, I take the same loss as found by Prof. Kennedy, namely, 2 per cent., which makes the indicated efficiency nearly 40 per cent. The efficiency of the air engine he found to be, with cold air, 67 per cent., making the total efficiency of the system 26.7 per cent. By adopting air storage we could, therefore, obtain 26¾ h. p. hours for every 100 h. p. hours indicated in the engine. Now let us see how the case stands with electrical storage. The efficiency of the steam dynamo, that is, the ratio of the electrical output to the indicated power, may be taken as 83 per cent., that of the batteries 80 per cent., and that of the motor at least 85 per cent., so that the total efficiency works out to quite 56 per cent., or more than twice that of the rival system. I have here assumed that the dynamo is steam-driven, simply because the only reliable figures I could obtain about compressed air referred to steam-driven compressors, but it is obvious that the comparison of the storage efficiencies of the two systems cannot be materially affected by the source of power, and will practically be the same in the case under consideration, where the power is supposed to be derived from falling water. We see that in efficiency, at least, air storage is far behind electrical storage. Let us now inquire whether it is any better off in the other essential feature I have mentioned—namely, in the cost of carriage. The information available under this head is tolerably reliable as regards batteries, but this is not the case as regards air stored under pressure. I know of no experiments made to determine accurately the weight of air reservoirs, and, in the absence of such data, I cannot do better than adopt the calculated figure given by Prof. Osborne Reynolds in one of his Cantor lectures delivered in 1888. According to this authority, the weight of the steel reservoir and air contained would amount to 300 lb. for every horse-power hour so stored. Now the weight of a secondary battery filled with liquid, and provided with a tray and connections, all complete, does not exceed 100 lb. per horse-power hour stored, that is, only one-third the weight of an equivalent air reservoir. We see, therefore, that as regards efficiency air storage is twice as bad, and as regards weight it is three times as bad as electric storage. Competition with it is, under these circumstances, obviously impossible, and we may therefore say that if the transmission of power from the waterfall to a distant point has to be made in the stored form, electricity is the only agent which may be considered.

Whether it would pay to transmit power is a question which cannot be answered off-hand. As compared with the direct transmission of live power by means of a pair of wires, the cartage of batteries up and down the country will no doubt appear to be a clumsy device, but when we are investigating the different possible solutions of an important problem we must not allow any preconceived opinions of what is elegant or clumsy to influence our judgment; we must, in fact, judge each case on its own merits, and I propose to deal with the electric transmission of stored energy in the same sense. The system of power transmission by storage batteries is actually in use, not, indeed, for long distance transmission pure and simple, as above defined, but still for transmission over distances reckoned by miles. I allude to the electric tram-cars worked by storage batteries, which are charged at a central depot, and run for many miles before they require to be again charged. The object is not to carry a certain amount of power in bulk from one point to another, but to dispense whatever power is required for the propulsion of the car during the journey. We might, however, imagine the tram-car, instead of being occupied by passengers, to be loaded with storage cells in addition to those it carries for its own propulsion. Whilst the latter would gradually lose their charge in transit between the two terminuses, the former would arrive fully charged, and could be made to give up part of the power stored in them at the starting point. Here we have transmission of power in the stored form, but let us return to our example of the waterfall and the mill, and see how such a system might be put into operation.

At the waterfall we establish the necessary hydraulic works, and an electric station where the batteries can be conveniently charged. We further build a tram line or railway, joining the charging station with the mill where the power is wanted, and we design the rolling stock with special regard to the safe and convenient carriage of the batteries to and fro. The train is fitted with electromotors, so as to make it self-propelling. A train load of charged cells is thus taken to the mill, and left there to work the electromotor which supplies power to the mill. During this process the batteries become gradually exhausted, and must be disconnected from the motor before they are quite exhausted, because we must allow a sufficient margin of power for taking the train back to the charging station. The economy of the whole system will evidently be the greater the less power is spent in the outward and home journey; and we might call "efficiency of transmission" the ratio of the power actually delivered to the motor, and that which might be so delivered if the battery were used for working a motor at the charging station itself; in other words, if the distance of transmission were nought. Say, for instance, that a total of 1,000 h. p. hours could be obtained from the battery, if it were discharged immediately, and that the power spent in the outward journey amounts to 50 h. p. hours, then a further 50 h. p. hours will have to be spent in the return journey, and the power obtainable at the mill will only amount to 900 h. p. hours. The efficiency of transmission will in this case be 90 per cent. If we double the distance between the waterfall and the mill, the efficiency of transmission would be reduced to 80 per cent.; if we treble the distance, the efficiency would only be 70 per cent., and so on. The efficiency must naturally depend on the kind of road over which the transmission takes place; it will be small on a common carriage road, larger on a tramway, larger still on a railway, and largest on a canal. We can, for every arrangement, express the value of the system, as far as economy of power is concerned, in one of two ways. We can, if the distance is fixed, give the efficiency in the usual way as a percentage, or we can fix a standard percentage of efficiency, and ascertain the distance over which this standard is attainable in any particular case. I shall adopt the latter way of reckoning, as the more convenient for comparison with other methods for transmitting power, whether in the stored or live form.

First, as to the transmission of stored power otherwise than by batteries. The only two methods we need consider are the carriage of corn and the carriage of coal, each combined with the use of a proper engine for converting the stored into live power at the other terminus of the line of transmission. In the case of corn, the starting point of this line is the field where the corn is grown. We there load it into suitable vehicles, and send it to the mill where the power is wanted. Since we are dealing now entirely with animal power, we must suppose the cartage to be effected by draft animals, say horses, and the conversion of corn into live power at the mill also by such animals. I need hardly say that, at the present time, no English mill owner would dream of working his mill in this fashion by animal power, since coal is yet abundant, and a single steam-engine is a far cheaper and handier instrument for producing and controlling a large amount of power than an equivalent number of horses. On the other hand, if power is required in small quantities, and in particular ways, then the horse will produce this power better, more cheaply, and more conveniently than the steam engine. It may seem absurd to work a large cotton mill by horse gear, but substitute for the mill a farm, and you see at once that the transmission of stored power to it, in the shape of corn, is a necessary part of the agricultural operations. Now, the horses, in bringing the corn to the place where the power is required, perform work, and must consume an equivalent amount of food. They also perform work in bringing the empty carts back again to the field to be re-charged. The ratio between the amount of corn delivered at the mill and the amount taken out of the field would therefore represent the efficiency of transmission. If this is to be 90 per cent., as in the case of electric transmission, we may take it that, for every 100 sacks of corn taken away from the field, the horses would eat on the outward journey (when the carts are heavily laden) 6½ sacks, and on the homeward journey (when they are empty) 3½ sacks, leaving 90 sacks of corn to be converted into live power at the mill. The distance to which we can thus carry stored power with a standard efficiency of transmission is a measure of the merit of the system, as far as economy of power is concerned.

The transmission of stored power in the shape of fuel is a parallel case. We load the coal at the pit's mouth into waggons, and haul them by means of locomotive engines to the places where the power is wanted. Part of the coal is consumed on the outward and homeward journey of the train, leaving the rest for the production of live power at the mill. If this amounts to 90 tons out of every 100 tons put on the train at the pit's mouth, we have again an efficiency of transmission of 90 per cent.

I have already mentioned that the exact distance to which we can carry power by either of the three agents here mentioned (namely, batteries, corn, and coal), depends very much on the kind of road over which the transmission takes place. We might assume an almost infinite variety of cases, but, as our object is to obtain a rough general comparison of the different systems rather than exact figures for any one of them, I have assumed merely three kinds of roads, namely, a common carriage road, a tramway, and railway, and have calculated the distance to which power can be transmitted in each case with a loss of 10 per cent. The results of these calculations are given in the following table:

TRANSMISSION OF STORED POWER.

Source of power.	Distance in miles attainable with 90 per cent. efficiency of transmission over:—		
	Road.	Tram.	Rail.
Coal and steam engine.....	115	270	1,300
Corn and horse.....	52	170	440
Storage battery and electromotor....	4	10	26

The speed of transmission has been assumed at four, six, and twenty miles of road, tram, and rail respectively, when coal or batteries are the transmitting agents; and at four miles on all kinds of road where corn is the transmitting agent. In all cases I have assumed that the road is the best of its kind, perfectly free from gradients or curves, and that the traffic can be worked at the speeds mentioned without interruption. In reality, these conditions will of course not be fulfilled; we have to make allowance for waste of power on gradients, curves, bad places in the roads, for running at variable speed, and for stopping and start-

ing. The distances given in the table are, therefore, throughout too large; but, as our purpose is merely the comparison of the different systems, we may take the figures in the table as a rough indication of the merits of each.

You will see, from this table, that as regards efficiency, the electric transmission of stored power cannot compete with the other two methods. A horse and cart carrying corn over an ordinary carriage road works with twice the efficiency of the electric locomotive taking batteries over a railway. The discrepancy is still greater if we compare the electric locomotive hauling batteries with the steam locomotive hauling coal. The latter can transmit power over a distance fifty times that over which the former can transmit power with an equal efficiency. On a train line the distance over which we can transmit power with an efficiency of 90 per cent. is, according to the table, 10 miles; that is to say, if the whole load of the car is composed of batteries, we can run it 10 miles out and 10 miles home at an expenditure of 10 per cent. of the total charge of the batteries. Now let us see how this compares with the storage cars in use on passenger tram lines. The total weight of a full-sized car is about 10 tons, made up somewhat as follows: Car and propelling gear, 4 tons; batteries, 2½ tons; passengers, 3½ tons. If the 3½ tons represented by the passengers were utilized for additional storage cells, the car could run 20 miles with the loss of 10 per cent. of its charge; or it could run 200 miles if losing the whole of its charge. As there are, however, only 2½ tons of batteries instead of 6 tons, it can only run 86 miles. This is according to the table, and more than attainable in practice, for the reasons already stated. Experience has shown that storage cars can only run from 30 to 60 miles with one set of batteries, or half the distance stated in the table. If we apply the same reduction to all the methods of transmission, we find that the distances to which power can be carried electrically in the stored form, with an efficiency of 90 per cent., are two, five, and 18 miles over a carriage road, tramway, and railway respectively.

The efficiency of transmission is, however, not the only or even the most important consideration in the problem of transmitting power to a distance. The owner of a transmission plant cares nothing for any theoretical perfection in the way of high efficiency. All he cares for is the cost at which the power is delivered to him. All other things being equal, high efficiency will naturally reduce this cost, and, in so far, is an advantage, but in practice all other things are not equal, and to aim at high efficiency regardless of other considerations is the reverse of good engineering. It is no doubt gratifying to the engineer if he can point to a transmission plant designed by him to give some extraordinarily high efficiency, but if the result has been maintained by means of an exorbitant capital outlay and excessive working expenses, it will not be equally gratifying to his employer, the owner of the installation, who has to pay for its erection and working. It therefore becomes the duty of the engineer so to plan the installation that the cost of the power delivered shall be a minimum under any given circumstances.

We have seen that, as judged by the efficiency standard alone, electric transmission of power in the stored form is hopelessly behind the other two methods which we compared with it. Let us now see whether this is or is not the case if we judge the system by the more practical and, indeed, the only reliable test of cost. It is, of course, understood that, in estimating the annual cost at so many pounds per horse power delivered, we take into account not only the cost of coal burnt throughout the year, if we obtain the power by steam, or the rent for water if we use a turbine, but also all other expenses which may properly be charged to the power account, such as wages for the attendants, petty stores, interest, repairs, and depreciation of plant. Estimated in this way the cost of water power will be found to vary between £2 and £8 per annum, the exact figure depending, of course, on the total amount of power available, the quantity of water, its fall and local conditions, which must largely influence the cost of the hydraulic works. The cases where water-power can be had at so low a price as £2 a year are exceptional; on the other hand, if we have to pay as much as £8 a year for water-power, it will seldom be worth while to transmit it electrically, or in any other way; and I shall, therefore, assume £3 and £6 as the limits of cost for water-power intended for electric transmission. The cost of steam power, if produced by large economical engines, is generally taken at £10 per year; if produced by small, and therefore less economical engines, it may rise to £20, and even £40 per year. I shall further assume that in all cases the power is required for 3,000 hours during the year, that is, 300 working days of 10 hours. At the outset, it is clear that if we wish to transmit large parcels of power—say 100 h. p. and upwards—by storage batteries, we must be able to deliver the power at a cost higher, it would obviously pay better to establish a local steam-engine. I have already mentioned that a system of battery transmission can be made to yield 56 per cent. efficiency, if we allow 10 per cent. for the transmission itself. To deliver 100 h. p. we must, therefore, charge with 178 h. p. during the time equal to that during which the power is required. If, therefore, at the generating station the annual horse-power costs £3, the charge for power alone will be £5 6s. at the receiving station. To this must be added the cost of labor and the interest and depreciation of plant, which, in this case, consists of the generating dynamo, motor batteries, and line of transmission, with its equipment of locomotives and waggons. The small storage cells, as now made, for lighting and power purposes, cost about £40 per horse-power; but let us assume that the larger cells, such as we would require, could be had for £30 per horse power, then a battery to work a 100 h. p. would cost £3,330. In order to economize carriage, and to reduce the wear and tear of cells, it would be advantageous to have two batteries, one being charged while the other is at work. We have thus an initial outlay of £6,660 for batteries alone. The interest and depreciation on these will certainly not be less than 15 per cent., or £10 per horse-power. Add to this, the cost of power at the generating station, that of labor and interest and depreciation on the electric machinery and the line, and you will see that it is quite impossible to compete with battery transmission against a local steam-engine, if the power produced by the latter costs £10 per annum. But how does the case stand, if the amount of power required is so small that it cannot be produced at this low figure? If we want only 5 h. p., and if we produce it by a local steam or gas engine, we shall have to pay for each horse power £20 to £40 per annum. Will it, in this case, pay to transmit by means of batteries, the power produced by a large and economical steam-engine at some central station? If we have to build a tramway or railway for this purpose specially, it will certainly not pay; but let us assume that a tramway already exists, and let us investigate whether the company, which we suppose is working the line by storage cars, could afford to sell to a customer on the line power at a cheaper rate than he could produce by a local engine. Let us assume, by way of example, that the customer requires 5 h. p. for 10 hours daily. The battery to work a 5 h. p. motor will weigh about 2½ tons, and cost £170. The charging dynamo, motor, and regulating gear will cost about £150, so that the whole capital outlay, if we provide two batteries, will amount to £490.

(To be Continued.)

THE ENGINEER OF THE FUTURE.

SINCE the introduction of electricity into common, matter of fact, every day life, says W. D. Tomlin, in *Practical Electricity*, the demands for economical power have pressed hard on the brain of the constructing engineer. Some men have boasted that steam as a motive power is doomed and its days are numbered, that electricity is the coming power. Perhaps it is, but the recent developments tend toward the employment of stupendous steam power to produce electricity; simply because electricity can be distributed at a far less percentage of loss than any other motor. You cannot carry steam 200 feet without considerable condensation, but you can distribute electricity nearly 200 miles, and at the point of distribution your amperes will be almost initial. You cannot transmit h. p. by gearing, rope, belting or otherwise without a loss of power by slippage, friction or kindred causes; but you can distribute electricity through ten miles of lines and give to each renter his pound of electricity through a small dynamo just in proportion as his contract calls for. Young men, I can assure you of one thing,—go into the city and ask for employment as engineer; about the first thing you are asked, is: "Do you know anything about taking care of a dynamo or electric plant?" "No;" "Well, we don't want you. Good morning!" It has become almost a necessity that an engineer should know something of electricity if he expects to secure employment. But on the different motor lines, the effect, to an engineer whose earlier experience has been with slide valve, is almost paralyzing. Some form of Corliss valve gear, but the steam expanded through three cylinders and then condensed. The apparent complexity becomes simplicity itself when in the hands of a single man who operates the engine for expansion results, with cylinders 16½", 28", and 42" by 60" stroke at 65 rev., in 150 pounds initial pressure, giving 1,400 h. p. Look through any prominent engineering journal, and you will find from a dozen to fifteen valve gear motions. An adjunct of the Corliss engine is the indicator,—and the time is rapidly coming to us when an engineer's education will be incomplete who cannot use an indicator and adjust the valves of his engine. What the stethoscope is to the doctor, the indicator is to the engineer. Both the professions are thus enabled to examine the breathing organs of the patient. The use of an indicator, while reflecting credit on the engineer who can use it, is a possible benefit to the steam user and owner; because thereby the coal pile is considered. The owner gets the full benefit of every pound of fuel saved, the saving being a bona-fide transaction often affecting the balance of a set of books from a debt to the credit account.

The time is close at hand when an indicator will be a part of the engine room outfit, and a daily engine log be as carefully kept as the double entry set of books in the general office.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

THE fifth annual dinner of the above Society was held at the Richardson House, Toronto, on the evening of the 11th of November. There was a good attendance of members and invited guests, and as on former occasions, the evening throughout was one of pleasure and profit.

Mr. W. Lewis occupied the chair, and in his introductory remarks said :—"We always look forward to our anniversary dinner with pleasure, and I wish to say for the information of the gentlemen present to-night who are not members, that our Association is progressing favorably. Of course we have not as many members as we should have, but the Association is steadily gaining ground, and as far as engineering is concerned, I know it is a good thing for any man. I ask all present to respond to the toast of "Her Majesty the Queen" by singing heartily the national anthem.

Mr. Geo. Grant followed with a song, receiving a hearty encore.

Mr. J. A. Wills responded to "Canada Our Home," and said: "Brethren, as a true Canadian, words cannot express my feelings towards this gathering tonight ; regarding this country I wish to say that as long as her sons stand, it cannot be shaken. We have in this young land a steamship line, and a railroad second to none. Our manufacturers can turn out engines and machinery equal to any other country, and Canadians in general can take their place with the people of any other nation."

Mr. Blackgrove followed with a song.

Prof. Galbraith, of the School of Practical Science, said that this was the fifth dinner he had had the pleasure of attending under the auspices of the Association, and he trusted it would not be the last. He hoped to have the pleasure of inviting them all up some evening to try their skill in running the engines, and he would give them a good fair test. He continued : You know we are making endeavors to promote education in this city, not only for those who can give up their whole time, but for others who can come in the evenings. Men entering this line of work require a certain amount of education and a certain amount of mathematics. The evening school was mainly for the benefit of the city, as young men coming from other places would be under expense and would want to devote their whole time to the instruction given them. These schools should be under the Minister of Education. I notice here your motto, "Knowledge is Power," and it struck me that there are different kinds of knowledge that make power. One kind of knowledge is gained by a man's own experience ; another kind we call instinctive knowledge—that you feel in your bones and cannot impart to others—and others that I will not now attempt to explain. I thank you for your kind attention, and hope in the future as in the past, the society will increase in membership and go on in this good work.

Mr. John Inglis said he was very glad to see so much interest manifested, and thought the society deserved a great deal of credit. As a manufacturing city, he thought Toronto stood at the head in Canada. He came here ten years ago, and had never regretted doing so. He observed in that period a vast growth in all the different branches of industry. In referring to past years he remarked how many young men had had to go out into the world without any education at all, and poor people could not think of attending a technical school. Now it is different, and he was glad that Toronto had taken it in hand to help young men to get a higher education. He was very much pleased to be present and hoped it would not be the last time, as the occasion had proved a very happy one to him.

Mr. Brown, of Galt, Ont., was pleased to be present. He could not say it was the first time he had enjoyed the hospitality of this Association, as he had a very enjoyable time at the picnic in July last. It was difficult to imagine the good the Association had done and is doing. There was a good class of men looking after the work. It was the duty of each one to help his fellow. By instructing their brethren they would also be helping themselves.

Mr. Dixon was glad to note the progress that steam engineering had made. He remembered when a boy the question being asked at school, "What is steam ?" and that one boy answered that it was "hot water under a very heavy perspiration." No matter how low the perspiration was, it required special attention. The society had made a step in the right direction in seeking to place men in this calling at the head of their profession. The society being both benevolent and educational, there was not a doubt but that it would prosper.

Mr. Watts wished the society every success, as he knew the grand work it was doing to promote engineering knowledge.

Mr. Robb, of Hamilton, remarked that the branch of the society in that city was advancing rapidly, and now has 40 members in good standing. He was glad that such an Association had been started in our country, and thought that any man desirous of learning would receive benefit from its meetings. He trusted that this would not be his last time with them.

Messrs. Kenney, Oliver, Orr, Montgomery, and others expressed their desire that the society should continue to advance.

Mr. Wickens returned thanks for the many kind words spoken of the Canadian Association of Stationary Engineers. This was a meeting very near to his heart. While a good deal had been said, there had not been anything said about the work of the Association. The members met together every two weeks for social and beneficial instruction. Different subjects of a technical character were discussed, all being interested and benefitted. The branches of the society now extended from Montreal to Brandon, Man. Referring to the time that is to come, he remarked that a few years ago an engineer was little thought of. It was now different, and the time was coming when an engineer would occupy a much higher position in public estimation than at present. In conclusion, if the engineers would band themselves together, there was not a doubt but that they would be able to "keep up with the procession."

ABOUT STEAM PUMPS.

THE distance that a pump will lift or draw water, as it is termed, is about 33 feet, because water of one-inch area 33 feet weighs 14.7 pounds ; but pumps must be in good order to lift 33 feet, and all pipes must be air-tight. Pumps will give better satisfaction lifting from 22 to 25 feet. There are many things to be considered in locating steam pumps, such as the source from which the water is obtained, the point of delivery, and the quantity required in a given time ; whether the water is to be lifted or flowed to the pump ; whether it is to be forced directly into the boiler, or raised into a tank 25, 50 or 100 feet above the pump.

When purchasing a steam pump to supply a steam boiler, one should be selected capable of delivering one cubic foot of water per horse power per hour.

No pump, however good, will lift hot water, because as soon as the air is expelled from the barrel of the pump the vapor occupies the space, destroys the vacuum, and interferes with the supply of water. As a result of this the pump knocks. When it becomes necessary to pump hot water, the pump should be placed below the supply, so that the water may flow into the valve chamber.

The most necessary condition to the satisfactory working of the steam pump is a full and steady supply of water. The pipe connections should, in no case, be smaller than the openings in the pump. The suction lift and delivery pipes should be as straight and smooth on the inside as possible.

When the water contains chips, shavings or sawdust, a strainer should be placed on the lower end of the pipe.

When the lift is high, or the suction long, a foot valve should be placed on the end of the suction pipe, and the area of the foot valve should exceed the area of the pipe.

A suction air chamber is a great advantage to the pump when the lift is high.

The area of the steam and exhaust pipes should in all cases be fully as large as the nipples in the pump to which they are attached.

The cylinders of steam pumps should in all cases be oiled before starting in the morning or stopping at night.

Stuffing boxes on the piston and valve rods should in all cases be kept with soft, moist packing, as, if the packing is allowed to become hard and dry, it will flute the rods, inducing leakage, and necessitating repairs.

The air vessel on the delivery pipe of the steam pump should never be less than five times the area of the water cylinder.

When pumps are standing still, idle or out of service in cold weather, all the drain, drip and pet-cocks should be left open.

OHM'S LAW.

No exact ideas are possible about the action of electricity without a thorough understanding of Ohm's Law. This is as necessary to the electrician as correct ideas about the strength of materials are to the engineer. An electrical engineer has to deal quantitatively not only with electrical currents, but also with the pressure or potential at which they are supplied. The power of a river to turn a waterwheel is dependent both on the magnitude of the current of water and on the amount of the fall which the water suffers. The most important thing an engineer has to deal with is power, or rate of doing work; and this is measured both with electricity and with water by the product of the current and the difference of pressure or head. Instruments can be made to measure both quantities; but an engineer must not rely on subsequent measurements, he must be able to calculate in advance, and it is in this connection that Ohm's law is so important, for it states the relation between current and potential, and its value is all the greater because the relation is a simple one.

No relation such as Ohm's Law can be established until a general agreement is arrived at as to the way in which currents and potentials are to be measured. We have seen in Primer No. 1 that an electric current produces effects of various kinds, and each one of these may be taken as a basis of measurement. They are, however, not all equally suitable. Thus the strength of a current might be regarded as proportional to the excess of temperature of the conductor heated by the current above that of the atmosphere; but this would be a very bad definition, for the excess in question would be dependent on many circumstances over which the current would have no influence; it would be a very inconvenient definition of current strength, it would not fit in with any other, and it would be impossible to make measuring instruments agree among themselves. There are, however, two effects of an electric current which are found to be strictly proportional to each other. The magnetic force exerted by a current is found to be accurately proportional to the rate of decomposition of an electrolyte placed in circuit. If several voltameters or electrolytic resistances are placed one after the other in the same circuit, the rates of decomposition bear a constant ratio to each other; so that if one is doubled all the others are doubled, even though the electrolytes are quite different in the various voltameters. The magnetic and electrolytic definitions of current strength thus lead to the same result; and, chiefly for this reason, the magnetic definition is adopted, and current meters are graduated in accordance with it. Similar reasons determine the way in which potential is measured, the definition adopted depending on the force of attraction exerted between two electrically charged parallel plates whose linear dimensions are large compared with their distance apart.

Ohm's Law states that the difference of electric pressure, or potential, required to drive a current through a given conductor is strictly proportional to the magnitude of the current while the physical state of the conductor remains the same. The ratio of the two is defined to be the resistance of the conductor. This definition of resistance implies that the current (measured in amperes) flowing through a conductor is obtained by dividing the electric pressure or difference of potential (in volts) at its terminals by the resistance of the conductor measured in ohms. The law of Ohm implies more than this, however, for it states that a conductor whose resistance is one ohm has always a resistance of one ohm whatever the current flowing through it may be, provided only that no external influence, or indirect action of the current itself, conspires to alter the physical state of the conductor. The resistance of a conductor is thus a physical property of the substance itself, and is not dependent on the current flowing through it. If the resistance of a material varied with the current flowing, it would be very much harder to make calculations about conductors than it is by using Ohm's Law. To take an illustration from mechanics, if we are told that a given material will stand a pull of two tons per square inch we know that a bar whose section is four square inches will stand a pull of eight tons, because we are aware that, so long as the physical state of the material is not altered by heating or any other means, the strength of a bar is proportional to its section. This law, which corresponds with Ohm's Law, is very convenient for calculation, because, by means of one constant for a given material, we can calculate the strength of a bar of that substance, no matter what its section may be, by simply multiplying the section by the constant. In the above instance the constant 2 tons per square inch would be of little use to us if we were told it only applied to bars whose section was 4 square inches, and that for bars of any other section the constant would be different. Ohm's Law enables us to calculate from the dimensions of the conductor and a single constant of the material, called the specific resistance, what the resistance of the conductor is. We have no need to take the current into account, because it makes no difference.

The resistance of a conductor is proportional to its length; for if we take two similar conductors of resistance one ohm and join them in series, so that the end of one is connected with the beginning of the other, each will require one volt difference of potential to send an ampere through it, and hence the difference of potential of the unjoined ends when the current flowing is one ampere will be two volts. The resistance of the combined conductors, being by definition the ratio of the volts to the amperes, will therefore be two ohms, or twice the resistance of each. We may see similarly that the resistance of a conductor is inversely proportional to its section; for, if we connect the above-mentioned conductors in parallel, so that they are joined together at each end, and send a current through the combination, a difference of potential of one volt maintained at the ends will drive a current of one ampere through each conductor, and the total current transmitted by the compound conductor will be two amperes. The resistance will thus by definition be half an ohm, or half the resistance of the single conductor, while the section is double. To obtain the resistance of a conductor we thus multiply the specific resistance of the material by the length of the conductor and divide by the section. The resistance of a copper wire 1 mile long and one quarter of an inch in diameter may thus be calculated as follows:

The specific resistance of copper is 1·6 microhm (millionths of an ohm) per cubic centimetre.

The length of the conductor is 1760×36 inches,

or $$1760 \times 36 \times 2{\cdot}54 = 161{,}000 \text{ centimetres.}$$

The section of the conductor is $\frac{n}{4}(\frac{1}{4})^2$ square inches,

or $$\frac{n}{4} \times \frac{2{\cdot}54}{4} \times \frac{2{\cdot}54}{4} = {\cdot}32 \text{ square centimetre,}$$

and the resistance of the conductor is thus,

$$\frac{161{,}000}{0{\cdot}32} \times \frac{1{\cdot}6}{1{,}000{,}000} \text{ ohms} = 0{\cdot}8 \text{ ohm.}$$

As the specific resistance of copper is 0·6 microhm per cubic inch, we might have calculated the resistance of the above conductor without introducing the factors 2·54 if we had used the constant 0·6 instead of 1·6; but whether the centimetre or the inch be used for the unit of length it is always necessary to reduce the dimensions to the particular unit chosen.

Having calculated the resistance R of the conductor in ohms, we can find the number of volts V required to send a current C amperes through it by means of the formula,

$$V = CR;$$

and if a battery of electromotive force E and internal resistance r have its terminals connected with the ends of the conductor in question, the current flowing, which is obtained by dividing the electromotive force of the circuit by the *total* resistance, will be given by the formula,

$$C = \frac{E}{r + R}$$

The volts needed to drive this current through the battery will, in accordance with what we have said, be

$$v = C r$$

The volts at the terminals of the wire—that is, the difference of potential at the terminals of the battery—is $V = CR$, so that by addition we have

$$V + v = CR + Cr = C(R + r),$$

or, by comparison with the equation giving the value of C,

$$V + v = E.$$

So that the electromotive force E of the battery, which is a constant, is spent, partly in driving a current through the battery itself, and partly in sending the current through the wire; and the potential difference at the terminals of a cell differs from its fixed electromotive force by the number of volts necessary to drive the current through the battery. Although the electromotive force of a battery is constant, the useful part of it, that available for external purposes, varies with the current sent, unless the internal resistance of the cell is inappreciable.

The value of V is not always less than E.

When a current is sent through the battery in the opposite direction to that which the cell would naturally produce, V exceeds E by the product of Cr.—"*The Electrician*" *Primers.*

SAFETY VALVES—THEIR HISTORY, ANTECEDENTS, INVENTION AND CALCULATION.

By William Barnet le Van.

(Continued from November Number.)

The results of the two formulas are given below:

Formula 24, as calculated: $A=21.23\sqrt{\frac{1}{p}\left\{\frac{1}{p+15.052}+0.0195\right\}}$

Pressure in pounds per square inch.	10	20	30	40	50	60	70	80	100	120
Area of safety valve per square foot of grate (sq. inches).	1.33	0.815	0.589	0.465	0.384	0.328	0.287	0.257	0.209	0.178

Formula 25, as given in French law: $A=\frac{225\ G}{p+8.62}$

Pressure in pounds per square inch.	10	20	30	40	50	60	70	80	100	120
Area of safety valve per square foot of grate (sq. inches).	1.21	0.786	0.583	0.461	0.384	0.328	0.286	0.254	0.207	0.125

This coincidence of results could only have existed from having the same basis, and the difference of form of the two second terms can only have arisen from the using of some other and more tractable empirical formula for the volume of steam by those who originated the French rule.

The divergence below 20 pounds we do not consider essential, whether the calculated formula gives too large values or the French one gives too small, and we would recommend for adoption the more simple formula:

$$A=\frac{22.5\ G}{p+8.62} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 26$$

It next remains to show the results of this formula when applied to practical cases, so as to see how nearly it is corroborated by the use of our American stationary boiler-makers.

We give tables of two pressures—50 pounds and 80 pounds per square inch—and for areas of grates from 4 to 25 square feet of grate as follows:

Areas for Safety Valves for Boilers with 80 pounds Pressure ($A=0.254$), and with Grates of different Dimensions.

Surface of grate in square feet....	4	6	9	12	16	20	52
Estimated area of safety valve....	1	1.5	2.25	3	4	5	6.25
Estimated diameter of safety valve in nearest whole numbers of quarters of inches....	1¼	1½	1¾	2	2¼	2½	3

Areas for Safety Valves for Boilers with 50 pounds Pressure ($A=0.384$), and with Grates of different Dimensions.

Surface of grate in square feet....	4	6	9	12	16	20	25
Estimated area of safety valve....	1.52	2.28	3.42	4.56	6.08	7 60	8.50
Estimated diameter of safety valve in nearest whole number of quarters of inch	1½	1¾	2¼	2½	2¾	3¼	3½

We think these dimensions correspond very nearly to the practice of all experienced constructors, and exhibit at once the usual size of safety valve, and that of the main steam pipe, generally employed.

If we adopt the formula as expressing the proper areas of safety valves for stationary boilers, which are not prepared to burn upon their grates more than eight pounds of coal per hour on the average, we have next to show how it can be applied to other conditions. With natural draught, the rapidity of combustion depends, in a great measure, upon the intensity of the fire, and a maximum rate of 24 pounds may, and probably does, accompany an average rate of 8 pounds of coal per square foot of grate per hour; while with artificial draught, or blast, this rapidity of combustion is nearly independent of the condition of the fuel, and a maximum rate of 24 pounds will hardly be exceeded with an average one of 16 pounds. We think it safe to take this quantity of 16 pounds average combustion per hour, with or by the aid of induced or produced supply of air to the fuel (as with jets or by fans), as an equivalent to the one square foot of grate surface which he had taken as the unit of comparison with the area of the safety valve. That is, the area of one square foot of grate, *without* artificially accelerated draught, may be assumed to require the same area of safety valve, as the burning of 16 pounds of coal per hour, *with* such draught, properly demands

As regards those boilers which are heated by the waste heat of furnaces, or by the combustion of waste gases from some process of manufacture, the circumstances are too variable to admit of statement in any law, and only the judgment of competent mechanics upon the performance of such boilers or steam generators can determine the proper area of safety valves for them.

If the area given by the formula be applied to the opening of the seat of the safety valve, it is obvious that the vertical lift of the valve must be at least one-fourth the diameter, to have the same sectional area when open.

Hence, should any valve be so constructed that the range of motion will not admit, when fully raised, a lift equal to one-fourth the diameter of the opening of the seat of the valve, the sectional area actually given between the raised valve and the edge of the valve seat should be taken as that to which the rule applies.

And while the formula gives areas abundantly large to meet the general resistance to discharge, which proceeds from the necessary form of a disk resting upon, or placed in proximity to, a seat, we think we ought here to state that it is always advisable that the under sides of safety valve disks should have a globular or pointed form (whether with or without guide-wings), and not made flat, as they sometimes are, and that the disks be beveled-edged, resting upon a very narrow bevelled seat, and do not have a flat bearing. It may be well to state, also, that, as ordinarily constructed, a safety valve, after lifting and allowing a flow of steam all around the disk, does not continue to raise and allow all the steam, as formed, to escape at the constant pressure, but admits some elevation of pressure before opening wide. With the areas given by the formula, and where the disks have been shaped as we have before described, this increase of pressure will not exceed 10 per cent. of the initial load on the valve, and the additional resistance to opening is a safeguard against the too sudden relief of steam, to the derangement of the water circulation of the boiler.

The committee will only add, as regards further consideration of the form or description of safety valves, and as to legal requirements beyond the adequacy of the openings, that the subject becomes too extensive for them to consider.

As originally made in the days of Watt—almost as planned by Papin—the essential parts of the safety valve have substantially remained until this time. No patent covers its simplicity or improves its certainty, although there have been made and used a thousand kinds, and there are a hundred existing patents.

It can only be imperfect by palpable misconstruction, or unsafe by vicious intent, and we can only recommend the defects to competent inspection, with power to remedy, and the misuse to the punishment of the law. There is very little likelihood that a safety valve, properly constructed, and in proper hands, would get out of order or fail to act at the needed moment. But, on the supposition that such a catastrophe might occur, it has been thought by the committee, after much deliberation, that, in order to divide the small chance for failure, it may be as well to make it a legal requirement, that in place of one safety valve, each and every boiler shall have at least two, the aggregate area of which should be that established by the formula.

These valves ought to be loaded with the same load, and blow off indiscriminately, so that either or both may be in action at once. This plan would call for, and insure, more care in graduating the loads on safety valves than is at present employed. The committee feel justified in observing that there are now in use more safety valves improperly graduated or marked than there are those imperfectly or unsuitably constructed. Lock-up safety valves afford but little protection from fraud or over-pressure and less security, unless frequently tested; and their use is decidedly discountenanced by the committee. We conclude our discussion of this branch of the subject committed to us, by recommending for the approval of the Institute the following

SCHEDULE,

giving the least aggregate area of safety valves (being the least sectional area for the discharge of steam) to be placed upon all stationary boilers with natural or chimney draft. This area may be expressed by the formula:

$$A=\frac{22.5\ G}{p+8.62}$$

in which

A=area of combined safety valve in square inches.

G=surface of grate in square feet.

p=pressure of steam in pounds per square inch to be carried in the boiler above the atmosphere, as shown by the steam guage.

The following table gives the results of the formula for one square foot of grate, as applied to boilers used at different pressures:

Pressure in lbs per sq. inch.	10	20	30	40	50	60	70	80	90	100	120
Area in sq. ins. corresponding to each square foot of grate.	1.21	0.79	0.58	0.46	0.38	0.33	0 29	0.25	0.23	0.21	0.17

We give one example of the application of the figures given by the table:

Suppose the boiler to be worked under 60 pounds pressure, then each square foot of grate surface should have an area of safety valve, by the table, of } =0.33 square inch.

Suppose the boiler to have 18½ square feet of grate surface } =18.5

$18.5\times0.33=6.105$ square inches area for the safety valve.

This would call for two safety valves, each having an area of 3.05 square

inches, or a diameter of 2 inches. Where boilers have a forced or artificial draft, the combustion of 16 pounds of coal per hour should be taken as equivalent to the one square foot of grate surface=G in the above formula and table.

Where boilers are heated by the waste heat of furnaces, or otherwise than by fire upon grates, the value to be taken for G must be estimated by some competent person, based upon the comparative performance of boilers with others heated in the usual way.

And the committee would report on the second branch of the subject referred to them—the legal requirements which ought to be made as to pressure guages—that the time allotted to them has not permitted a complete investigation. The great advantage which any of these instruments possess is found in their indicating the pressure of steam within a boiler, so as to allow a fireman to regulate his supply of fuel with economy. There are many kinds and forms of gauges, almost every one of which has some characteristic superiority over all, or most other kinds and forms, but we do not wish to say that any of them are perfectly or permanently reliable.

And your committee would ask to be relieved from further consideration of the subjects referred to them.

ROBERT BRIGGS,
COLEMAN SELLERS,
J. VAUGHAN MERRICK,
WM. BARNET LE VAN.

AREAS OF VALVES AS RECOMMENDED BY THE FOLLOWING COUNTRIES.

Steam pressure p as per Steam Gauge.	British $A=\frac{G}{2}$	Scottish. $A=\frac{G\ 18}{p+15}$	Prussian. $A=\frac{1.2}{p+15}\square$	America, Franklin Institute. $A=\frac{G\ 22.5}{p+8.62}$
5	10	36	36	33
10	10	28.8	28.8	23.11
15	10	24	24	19
20	10	20.4	20.4	15.7
25	10	18	18	13.38
30	10	16	15.6	11.6
35	10	14.4	14.4	10.3
40	10	13	12.6	9.25
45	10	12	12	8 4
50	10	11	10.8	7.6
55	10	10.28	10.2	7
60	10	9.6	9.6	6.5
65	10	9	9	6
70	10	8.46	8.4	5.7
75	10	8	7.8	5.3
80	10	7.58	7.5	5
85	10	7.2	7.2	4.8
90	10	6.84	6.84	4.5
95	10	6.54	6.54	4.34
100	10	6.26	6.24	4.14

It will hereafter be shown by the experiments of James Brownlee, of the Institution of Engineers and Ship-Builders, in Scotland, that the Franklin Institute formula, although giving the smallest area of valve, is, at all steam pressures above 25 pounds per square inch, when full open (one-quarter the diameter of valve outlet), five times that requisite to discharge all the steam generated; the Scottish and Prussian rule, nine times; while by the British formula it is four and a half times at 25 pounds steam pressure, and eighteen times more than is required at 130 pounds pressure; and this, after allowing for an evaporation of 3 pounds of water per minute per square foot of fire grate, which is considerably more than is usually realized in practice.

So that with properly constructed safety valves, which will rise one-fourth of their diameter by an increase of 1 to 5 pounds above the load, there is no necessity for the area being much (if any) more than one-fifth of that called for by the Franklin Institute formula.

But as boilers are made of iron and steel—and as these materials, like men, wear out—the Franklin Institute formula gives ample margin for reduction of the steam pressure as the boiler deteriorates with age, so by the time the area becomes too small the boiler will have to be renewed.

In 1874, a most interesting series of experiments on safety valves was made by a committee of the Institution of Engineers and Ship-Builders of Scotland. A discussion had arisen among the Scottish and English engineers relative to the proper construction of a safety valve, and the rules of the English Board of Trade as to the areas required and the mode of loading the valves.

In this trial two safety valves only were tested—those approved by the English Board of Trade—the united areas of which were one-half of a square inch area to each square foot of grate surface. The boiler used in this experiment was of the tubular kind, and the grate surface was 25 feet; the heating surface, 746 square feet. The safety valves were each 2⅞ inches diameter. The safety valves were loaded with weights direct.

(To be Continued.)

Charles Myles proposes to establish an electric railway between Hamilton and Grimsby.

The electric light has temporarily at least made its exit from the town of Richmond, Que. A correspondent writes "We did not properly appreciate the benefits of the light till we lost it."

The corporation of the town of Orillia, Ont., have seemingly ceased to regard electric lighting by the municipality in the light of a bonanza, and have sold their plant and given a contract for lighting to Mr. Byone.

SPARKS.

Edmonton, N.W.T., has a telephone exchange of thirty-one instruments, or one telephone for every twenty-two inhabitants.

The town council of Woodstock, Ont., is said to have refused to grant to the Edison Co. a franchise to install and operate an incandescent plant.

A pleasant event in social circles at Stratford, recently, was the marriage of Minnie, second daughter of Mr. John Reid, manager of the Stratford Gas and Electric Light Co., to Dr. E. H. Eidt.

The electric street car traffic in New Westminster is said to be fairly good, and the demand for seats or even standing room on the inter-city electric tram cars is about double the present supply.

Mr. W. C. McDonald has presented to McGill College a library of 295 volumes, in English, French and German, comprising the leading works on electrical science and its application to industrial uses. There are also a number of works on mechanical and other scientific subjects.

One of the cars of the Ottawa electric street railway collided with a lumber train at a crossing the other evening, owing to the motorneer not seeing the railway signal man's light. The motorneer reversed so as to save part of the shock. The five passengers were badly shaken, but nobody was seriously hurt. The car was wrecked.

At a meeting of the Committee on Electricity, Electrical and Pneumatic Appliances, of the World's Columbian Exposition, held Oct. 26th, the following names were decided upon as those of eminent electricians not now living, to be placed over the electricity building at the exposition, namely:—Franklin, Galvani, Ampere, Faraday, Ohm, Sturgeon, Morse, Siemens, Davy, Volta, Henry, Oersted, Coulomb, Ronald, Page, Weber, Gilbert, Davenport, Soemmering, Don Silva, Arago, Daniell, Wheatstone, Jacobi, Gauss, Vail, Bain, De la Rive, Joule, Saussure, Cooke, Steinheil, Varley, Guericke, La Place, Channing, Pries ley, Maxwell, Coxe, Thales, Cavendish.

The North American Mill Building Co., of Stratford, Ont., gives notice of its intention to apply to have its corporate powers extended so that it will have (*a*) Authority to construct, maintain and operate works for the production, sale and distribution of electricity for the purposes of light, heat, and power; (*b*) Authority to enter into any contract for the supplying of electric or steam power to any person, firm or corporation; and (*c*) Authority to take and hold stock in any company now or hereafter to be incorporated for the purpose of constructing, maintaining and operating works for the production, sale and distribution of electricity for the purposes of light, heat and power.

Canadians feel justly proud of their fine telephone and telegraphic communications. The admirable telephone service enjoyed by Montreal and Toronto may be largely attributed to the fact that no one company has the monopoly of manufacturing telephones. The credit for this is greatly due to Mr. W. C. Hibbard, late of the Hibbard Electrical Manufacturing Co., of Montreal. The Bell Telephone Co. originally obtained in Canada the patents which they had previously secured in the United States; but instead of manufacturing their instruments in the country within one year, as the law demands, they brought the various parts from the States and put them together here, Mr. Hibbard grasped the situation and began to make telephones. Although the Bell Telephone Co. brought suit against him, they were defeated and the patent became invalid. Now anybody may manufacture telephones in Canada.—*Electricity.*

NOTES.

The same rule which applies to constant feed with pumps, says Robt. Grimshaw, in "Hints to Power Users," holds good where injectors are used; there should always be a stream of water going into the boiler; so long as there is a current of steam going out of it.

The proprietors of the Ridgetown, Ont., roller mills recently commenced to use natural gas as a fuel in their engine room. The gas is taken in through air mixers and through the bridge walls to the crown sheet of the boiler. Sixteen burners are used, eight on each side. The results are said to be entirely satisfactory.

Mr. A. E. Edkins, for some time past in charge of the steam and electric plant at Messrs. T. Eaton & Co.'s, Toronto, has accepted a position as inspector with the Boiler Insurance and Inspection Co., and will enter upon his duties at once. Mr. Wilson Phillips has been engaged by Messrs. Eaton & Co. to succeed Mr. Edkins.

A recent departure in obtaining extra draught for furnaces on steamships without the use of blowers or other devices has been successfully tried on the Scot, of the Cape Mail line. This vessel has been furnished with smoke stacks 120 feet high above the grates. The increased draught is equivalent to a water pressure of three-fourths of an inch.

TRADE NOTES.

We have pleasure in introducing to the readers of the NEWS the Toronto Electrical Construction and Supply Co., in whose advertisement appears an important announcement by the Thomson-Houston International Electric Co., of Boston, to the effect that they have appointed this company sole agents for their apparatus in Canada.

Mr. Alonzo W. Spooner, of Port Hope, Ont., whose name is familiar to our readers as the manufacturer of "Copperine" anti-friction metal, announces in this issue that he has secured the sole right to manufacture "Phenyle," a disinfectant, deoderizer and germicide, which is said to be effective in the prevention of disease in manufactories, dwellings, etc.

A PERFECT ELECTRICAL RAILWAY MOTOR.*

By H. A. Everett.

For the past eight years the writer has been very intensely interested in the perfection of electric motors. The first experiments were made in the summer of 1883, but during the previous winter we had been carefully watching the operation of an electric system in the private premises of one of the large manufacturing companies, and had seen the motor operate under all conditions of weather—though, of course, experimentally. We had come to the conclusion that it was just the thing, and had hopes that it would revolutionize travel the world over. On application to the city government we were given the right to build one-and-a-half miles of railway, with an electric conduit. The troubles and vexations we experienced with the conduit are not covered by the title of my paper, and I will endeavor to confine myself to explaining the changes that were required in the motor.

The first fundamental error made by the electricians was in the idea of increasing the voltage in proportion to the number of cars run, which of course would be impracticable in a system of any size, but we did not know that then. We got out our experimental car, and quite frequently, for a few hours, it would work magnificently, giving a speed of twenty-two miles per hour with the utmost ease, and running forward or backward with one or two loaded trailers in fine shape. We were quite well satisfied with the experiment with the one car, but insisted on having a second and third car placed on the line before adopting it generally. We finally got the second car running, and were very much dispirited to find that the speed of both cars was immediately reduced to about four miles per hour. This result was, of course, very unfortunate for us. Returning to my subject, in starting in with the motors we tried wire rope transmission from the armature to a drum on the axle, but it did not work at all satisfactorily, the ropes oftentimes stretching too much. We then tried manilla rope transmission, but that also had its weak points, and the change to friction gear also proved unsuccessful. After these various trials, the late Richard N. Allan requested us to allow him to gear it at his own expense, with a system of cog gearing which he was quite sure would prove successful. We very gladly gave him permission to put in the gearing, and (this style of gearing has been practically adopted by all the prominent electrical companies in the country) after trying to operate this line for about a year and three months, we gave the matter up for the time being, believing that it was impracticable either to operate a conduit, or to operate by the system as suggested at that time, though never losing faith in the final outcome of electrical propulsion. We examined a great many motors and travelled over a large part of the United States to observe tests made of storage batteries of various kinds, but we were not at all satisfied as to their own successful practical operation, and, until we saw the road operating at Richmond with overhead wires, we had no desire to again enter into the matter of electrical propulsion, although it must be admitted that some of our people were willing to put in a system similar to the one at Scranton, even before the Richmond system was in operation. An electrical motor of three years ago should hardly be compared with the motors manufactured at the present time, and on the other hand, a motor that is considered perfect, or nearly so now, might be considered old-fashioned and obsolete within a much shorter period. We have made several tests of storage battery systems, and have watched with great interest the many tests made in that branch, and candidly we must admit that the practical successful application of storage batteries for street railway propulsion seems as far in the future as it did five years ago. Almost all street railway men admit that the storage system, if successful, would be the ideal system, and all hope for its ultimate achievement ; and in this age of progress it would be very short-sighted and bigoted to say that it will ever come.

All of the prominent companies are eager to perfect their motors in the matter of details, and have cheerfully co-operated with the practical men running electric roads to bring about the improvement of their machinery. All the well-known systems of the day have some special points of advantage, but these I will not refer to, as it is not within my province to do so.

The motors when first constructed were altogether too light both mechanically and electrically, but these difficulties being overcome very rapidly, as well as the serious difficulty of too rapid motion, which swelled the operating expenses very largely in maintaining the parts and replacing the gearing. The best motors manufactured hereafter will be the most simple in the matter of the construction of the parts, and the same time not consuming too great a quantity of electricity, so that in addition to being simple they will also be economical. The principle of winding armatures is, of course, a pretty old one now, and each company is anxious to give its patrons the most efficient and best armature. I think it would be an improvement if in all machines made, a better insulated wire were used, in both armature and fields ; a more reliable and positive fuse application, one that would always burn out while still under the capacity of the motor would also be a great improvement.

A great many corporations in operating motors do not appear to be willing to give them proper attention or inspection, with the result that weak points are very soon apparent ; but this is in no way the fault of the manufacturer.

The writer expects within a very few years, as the motors are perfected and their armature speed reduced, to see a line of railway from New York to Chicago, run on the basis of not more than a two hour time-table for the through trip, and giving a transportation rate considered impossible with the present motive power. A great diversity of opinion exists as to the proper size of motor cars, a good many companies holding to the principle that a very large car is desirable and practicable. From our experience in operating cars from 16 to 30 feet in length, I am of the opinion that on routes having a small patronage, where the earnings are under 20 cents per car mile run, it is unwise and undesirable to have a car exceeding 21 feet in length inside, as it is much more economical to have trail cars when the traffic is heavy, rather than to be at the continuous daily expense of hauling a very large car of great weight.

I would again reiterate the fact that motors have been wonderfully perfected within the past year, and if as much progress is made during the coming year, there can be very little to ask in perfecting a motor, although it is very desirable that the mechanical application should be more carefully looked after. I do not think it was the intention to have me criticize in any way the special weak points of any system, but simply to refer to the whole in a general way. If you will pardon a short divergence from the subject, I will relate an incident which occurred last spring. A gentleman largely interested in street railways made the remark that in the city of New York they would never permit the use of electric motor cars, if accompanied with unsightly overhead wires. I asked him if it was quite consistent that so much objection should be made to a system that required but one copper wire, not exceeding three-eighths of an inch in diameter, with posts on either side of the street, 150 feet apart, with a diameter not greater than an ordinary hitching-post, after allowing on the street that beautiful structure, the "New York Elevated Railway," with its perfect (?) odorless, smokeless, noiseless steam locomotives, and shutting out both light and air to the people on the street where the railway is operated. He candidly admitted that he did not know but that the elevated road was about as bad as the overhead wires.

To resume my subject, at the present time all of the prominent companies are devoting the time and intellects of their best men to the perfection of a gearless motor. They all now have the single reduction motor in the market, which is certainly a wonderful achievement in advance of the late countershaft machines, and which ought to make a splendid exhibit when compared in the matter of operating expenses. But I have noticed one matter which the electrical companies seemed to have entirely overlooked in the manufacture of their apparatus, and I must say that this failure is universal.

All of the prominent companies seem to have fallen into the same error, and seem to persistently and malaciously continue in their evil ways. I do not think that any one subject connected with electric propulsion has received so much attention from the railways as this one and with so little co-operation and assistance from the electric companies. I, of course, refer to the price of their equipment. It appears to me that the companies, instead of operating 4,000 motor cars, could be operating 40,000 within a very short time, if they would bring the price down to a reasonable figure, so that all companies could afford to purchase an equipment, I think it would also be desirable if the electric companies would supply all the extra parts from their shops at a price allowing a reasonable margin for profit.

Before closing this paper, I desire to extend my sincere thanks to all the gentlemen connected with street railways who have so kindly given me the benefit of their experience on this subject.

In summing up my idea of a perfect street railway motor at the present time, I would say :

Taking the trolley wheel, pole and stand, I think it is desirable to have a wheel that is capable of following the wire at any angle, with a trolley pole brittle enough to break should it become en angled in the wires, without pulling them down, and a trolley spring rigid enough to give good, steady pressure on trolley wire, and so constructed that when the car is in the car house or going under a low bridge, the pole could come very close to the roof of the car, also flexible enough to give good pressure when the trolley has to be 21 or 22 feet high at the railway crossings.

The car should have a lamp circuit, with plenty of lamps distributed properly.

The perfect motor ought to have, as hereinbefore suggested, a reliable fuse plug that will invariably blow before injury is done to the machine.

Have on each car the best lightning arrester that can be secured in the market.

In coming to the motor proper, it is desirable to use a controlling switch that is easily operated and readily reversed in case of accidents. The simpler the controlling device the better, and it should be constructed with a view to guard against any possible disarrangement of the parts, so that it will be reliable in all cases, both electrically and mechanically.

The rheostat should also be carefully looked after and properly protected to keep it from injury by reason of water, snow or dirt getting upon it. It should only be available in starting the car to avoid the lunge of a start, and should be so arranged as to be cut out as soon as the car is started, and give the entire efficiency of the motor proper.

The motor should be well protected in all its parts from any outside interference, so that in running along the street it will be impossible to pick up nails, wire, or anything that would short circuit it, at the same time observing that a motor must be properly ventilated to keep it from heating while in use. The cover should be made so as to be easily removed.

I deem it very advisable to have an armatare of a large diameter, making a small number of revolutions per minute, while the bearings should be made of extreme width with proper grease-cups, and in such a condition that they can be readily re-babited when slightly worn.

The diameter of the commutator should also be large, and to have the brushes easy of access is very desirable. The winding of the armature

* Being a Paper read at the Tenth Annual Meeting of the American Street Railway Association, Pittsburg, Pa., Oct. 21, 1891.

ought to be of the simplest kind, and the size of the wire and insulation of same should be carefully looked after. I think the insulation of wires in armatures is at present one of the weakest points in the motor.

The armature gears should have a wide face, and run in oil. The armature shaft ought to be of ample diameter, and there is nothing gained by having the keyway too small for the securing of the commutator to the shaft. The commutator should be carefully insulated, so that there will be no grounds between it and the case. The box in which the gear runs ought to be constructed of copper, or some light material that is somewhat flexible, so that if struck from the outside it will bend rather than break. The fields should also be wound with a wire of better insulation, and of ample size to take the current. Of course, in this particular, I do not intend that the wire of either the field or armature should be great enough to take more horse-power than ought to be used by the machine. To my mind it is very desirable to have the armature in such a condition that it can be readily taken out from the machine and put in again.

One of the serious disadvantages to operators of electric roads is the expensive labor necessary in winding the armatures and fields, also in regard to high priced mechanics who ought to be employed to attend to the machines. There is nothing gained in employing a cheap class of labor to handle an electric equipment either as electricians, amature or field men or mechanics. This proposition is a self-evident truth, as can readily be observed in many roads now in operation.

At present I think the single reduction motor is the nearest perfection of any on the market.

I think it very desirable that the electric companies should devote some time to the perfection of an electric brake to stop the car with the same power that runs it. This could be readily done and would be a satisfactory improvement.

Electric heaters are now used in quite a number of places and I think will prove quite satisfactory.

I have noticed electric signal bells on some of the cars, and they seem to work very well.

For a dasher gong on a motor car I am in favor of a foot tread, as in testing an electric gong we found that men used it altogether too freely.

I am in favor of an oil head-light one that can be removed easily, so that in the event of a trolley being broken or anything happening to the electric part of the car, or a light is desired underneath the car, the oil head-light can be used to better advantage than the electric. There ought also to be one oil light in every car for the same purpose. There is no reason why an electric fare register cannot be made to work successfully.

The durability of the motor is a question which requires very careful attention. The single reduction motor when properly looked after, ought to last for many years. We have had one in operation for over 10 months and it appears to be in as good condition as when it first went on the road. The car should be of moderate size, constructed with all modern convenience but without fancy decorations or any unnecessary display.

The cars should be run on frequent headway and at all hours of the day and night, at as high a rate of speed as the civic authorities will permit. The noise of the motors has been very largely done away with, and by careful attention the old counter shaft machines can be used until worn out by simply covering the gearing with an oil box, and by not attempting to run them too many miles without inspection.

A residence at Peterboro' has been fitted with electric lighting apparatus.

An unprofitable warfare is being waged between the rival electric light companies in Stratford.

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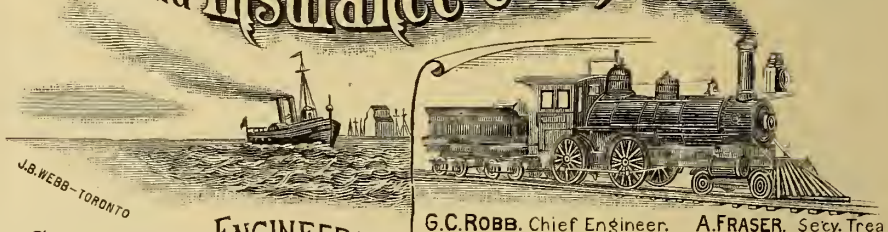
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Morrisburg will shortly have an electric light plant in operation.

The National Electric Tramway and Lighting Co., of Victoria, B. C., will light the streets of the village of Esquimault.

The Barrie Electric Light Co.'s new station is nearing completion. Its capacity will be sufficient for double the present service.

The dynamo in connection with the Hanover electric light plant was disabled by an accident recently, and the town is in darkness pending the purchase of a new one.

A new car, built by Patterson & Corbin, of St. Catharines, and fitted with the Edison Company's appliances, has recently been put in service on the Metropolitan Street Railway Co.'s tracks, North Toronto. The car is 18 feet long and can accommodate 70 passengers. It is provided with two motors of 15 horse power each, and is lighted by electricity. It will be heated by four Burton electric heaters, being the first car to be heated with electricity in Canada. The maximum rate of speed is 18 miles an hour, with ability to mount grades at a speed 10 to 12 miles an hour. By means of the controlling switch the car can be stopped within five feet if necessary, when going at full speed.

Notice is given of an application for letters patent to incorporate the Citizens' Light and Power Company, with a capital of $50,000. The headquarters are to be at Montreal. The objects of the company are to contract for, construct, operate and maintain a system or systems for the supply of electric light and power to cities, towns, villages and other municipalities, corporations and individuals in the Dominion of Canada, and to conduct such electricity by any means on, through, under or along the sides of streets, highways, bridges and public places of such cities, towns, villages and other municipalities or across or under any navigable waters in Canada, the consent of the governor-in-council having been first obtained, etc. The applicants are: Thomas Badenach, merchant; John Bronskill Clarkson, accountant; John Thomas Hagar, manufacturer; Thomas Joseph Drummond, merchant; Charles Morton, agent; Richard Wilton, accountant; Herbert Montague Linnell, electrician; Joseph Emile Vanier, engineer; David Walker McLaren, manufacturer, and William John White, advocate, of Montreal, of whom Drummond, Vanier, Hagar, White and Clarkson are to be the first or provisional directors.

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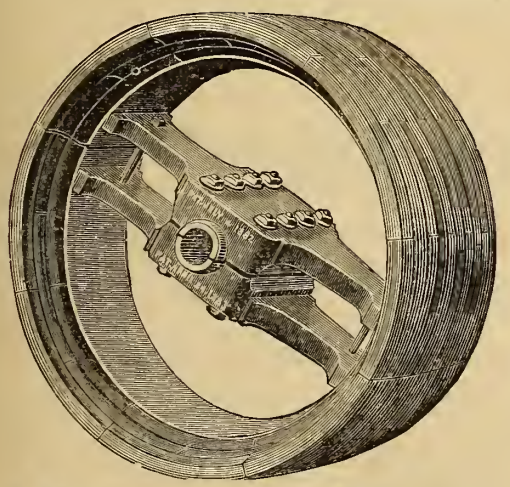
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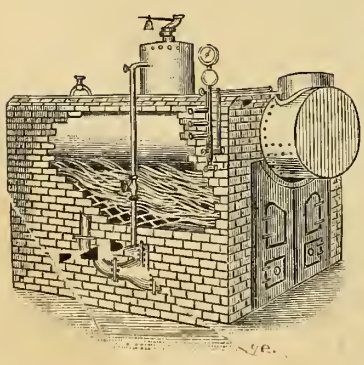
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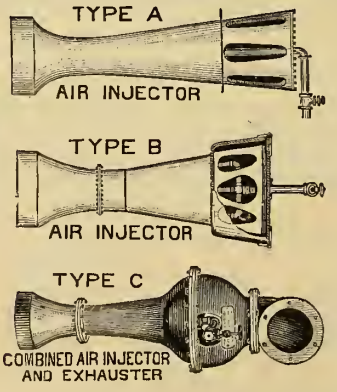
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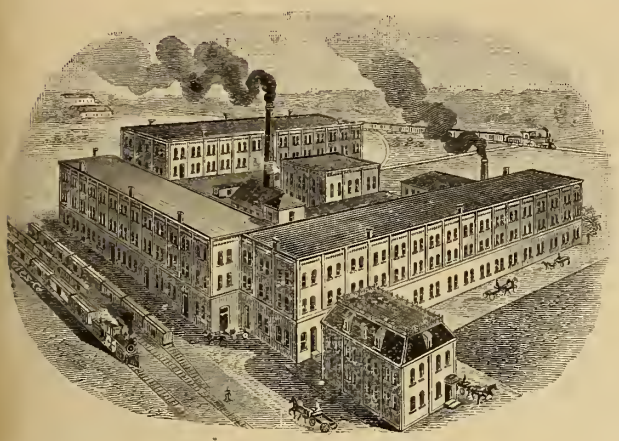
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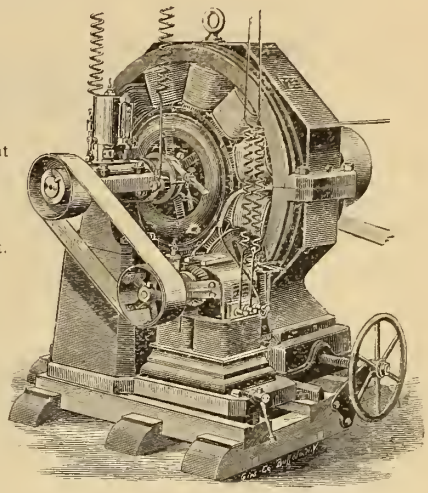
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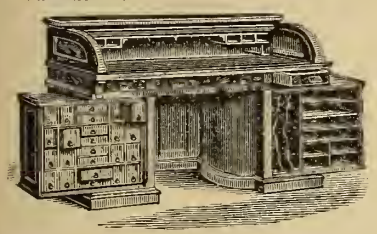
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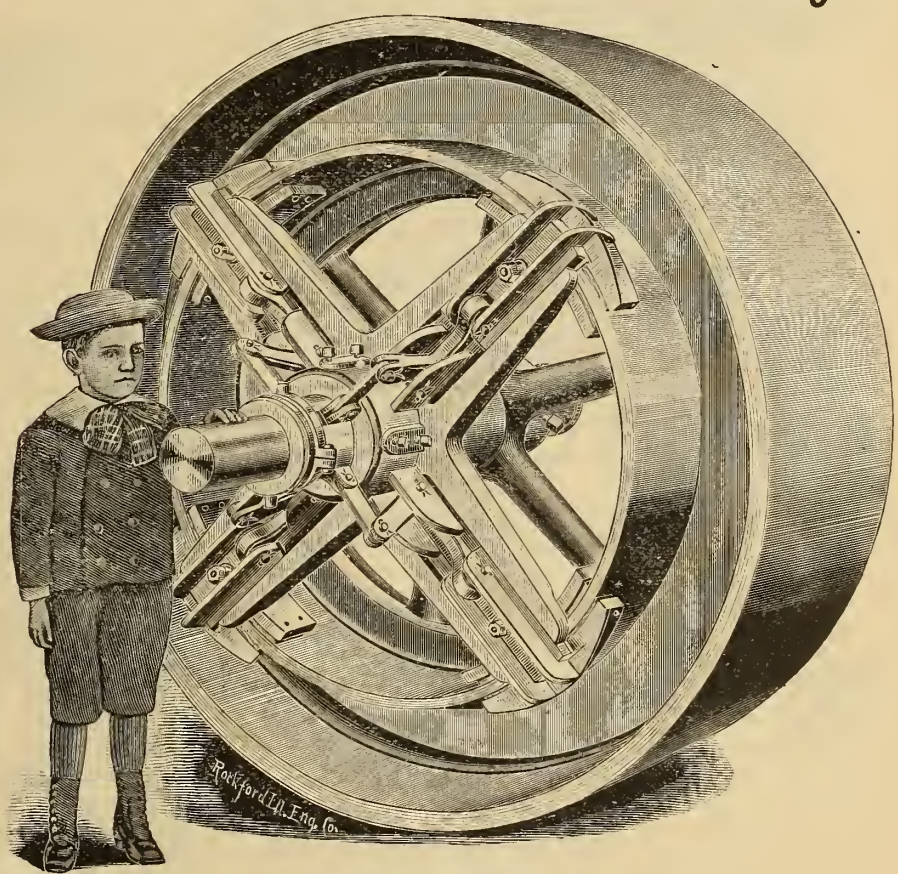
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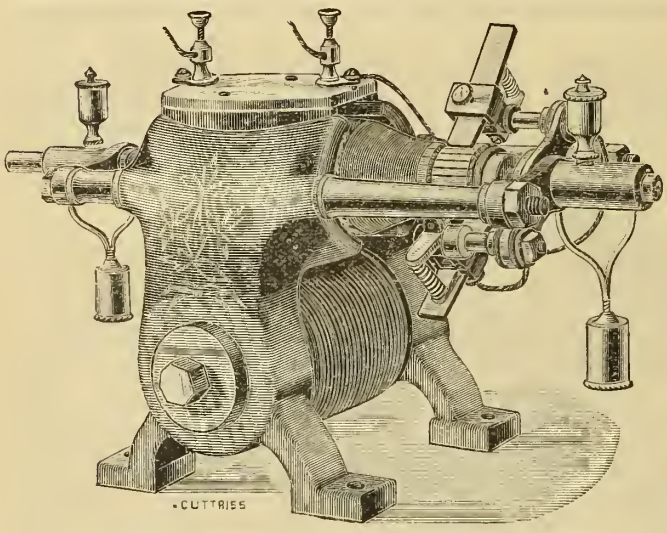
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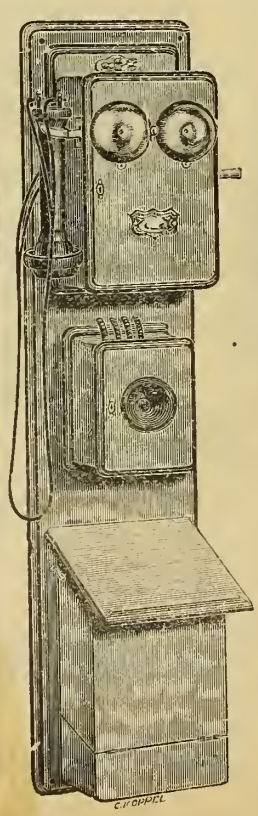
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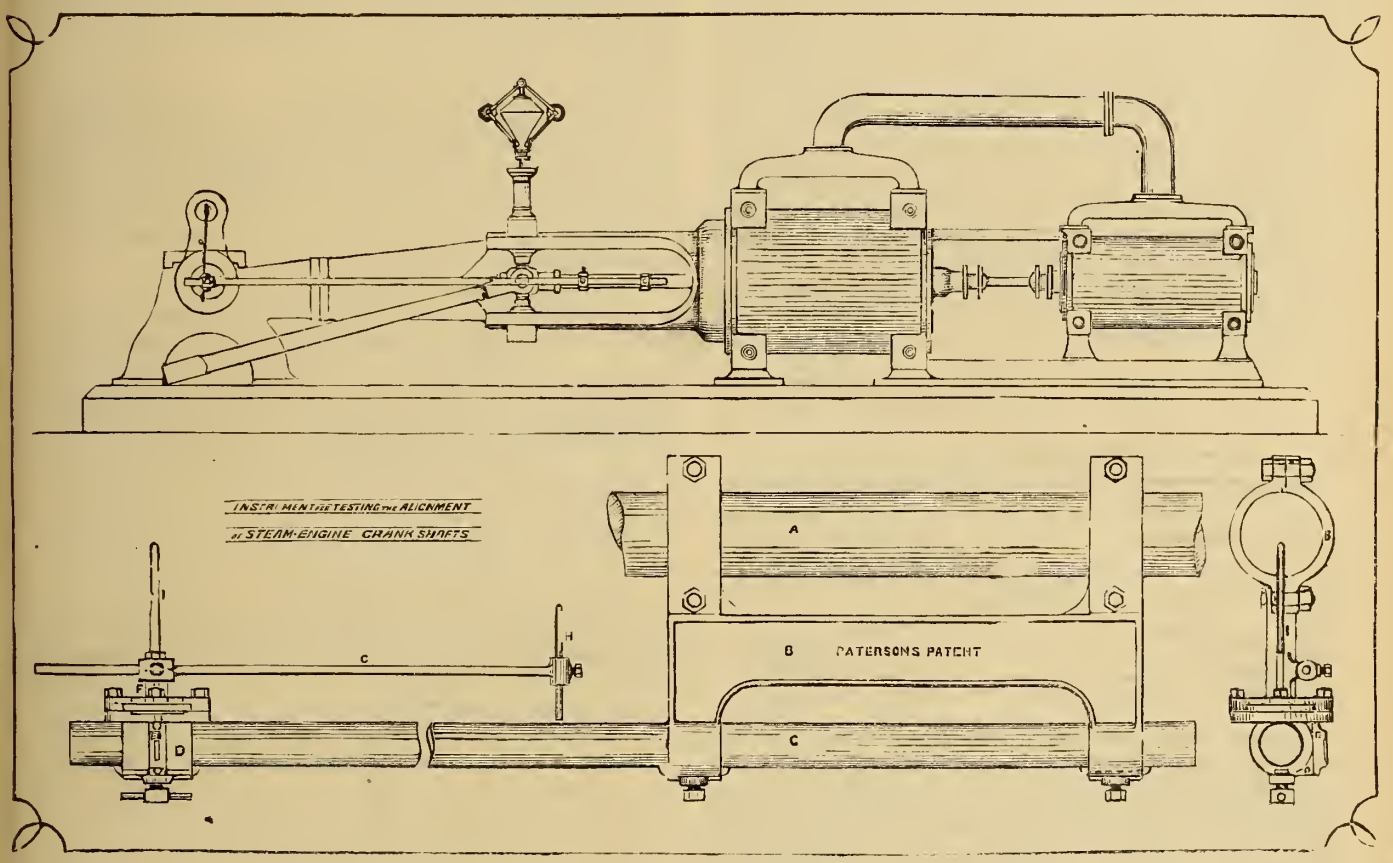
AND

STEAM ENGINEERING JOURNAL.

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TESTING THE ALIGNMENT OF CRANK SHAFTS.

AN instrument, for testing the alignment of steam engine crank shafts, an illustration of which appears in the accompanying engraving, has been patented by Mr. Paterson, of 7, Airlie-terrace, Dundee, which should prove very useful. It is specially designed for factory engines of the Corliss, Wheelock, and similar types, obviating the necessity for stoppage of a department to open the engine for readjustment. In fact, it only requires the connecting-rod released from crank pin, when the instrument will show the relative rectangular position of engine and shaft, of all. Being made for the largest engine it is only necessary to have bushings bored and in halves to fit the various sizes of piston rods, and turned outside to fit the frame, while any convenient length of tube may be used, as well as a number of pointers of various lengths. While not intended for use on engines with cylinders less than 10 in. diameter, they will be found a valuable adjunct to the class of engines for which they have been designed. The immunity from stoppages for readjustment, referred to above, is by no means the only source of economy derived from the periodical testing of engines with those



pointing out at the same time the slightest inaccuracy in the level of the shaft, which may be caused by the settlement of foundations or unequal wear. Being particularly devoid of complexity, a short description, reprinted from *Invention*, will suffice. A is the piston rod ; B a frame, preferably of brass and proportionately light for the duty which it has to perform ; C a tube of steel ; D adjustable head of brass fitted on its top side with a small level E ; F a disc fitted to rotate in head D, said disc being provided with a socket carrying the radial arm G, adjustable lengthwise and having fitted to it adjustably a steel pointer H ; I a pointer fitted in the end of disc F, and adapted to move endways therein, being for the purpose of setting the instrument in order that the pointer H may rotate concentric with the path of the crank pin, being subject to no strain during application other than that imparted by touch. Lightness forms an essential feature in their construction, and, although not liable to get out of order, their accuracy can be ascertained at any time. In extensive establishments, where a number of engines are employed, one instrument will generally be found to meet the requirements instruments. Hot bearings resulting from cross wear are avoided, a saving of brasses and oil thereby effected, and increase of power, while the risk of breaking connections is reduced to a minimum. The instrument may be tested thus : —By gauging a plumb line with the pointer H, the level will show the slightest inaccuracy, and by reversing said pointer and gauging the tube the other two points are found. To test the accuracy of the frame no explanation is required.

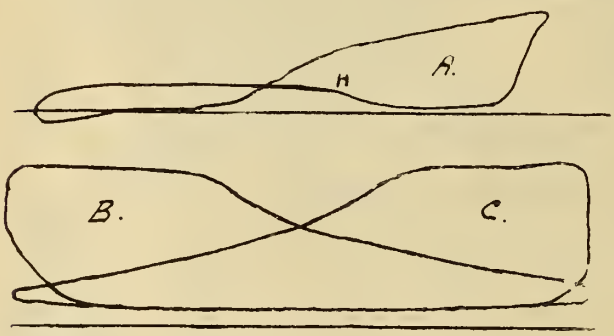
The application of the instrument is as follows : The connecting-rod being released from the crank pin, as shown, the cross-head is placed about one inch from its extreme outward travel, the frame B is then clasped on to the working part of the piston rod A, tube C is placed in position, head D is then set by its pointer I and level E, pointer H being adjusted to the centre of crank pin, pointer I is withdrawn clear of the shaft, which must have a true centre mark for setting, and be prevented at all times from being moved endways while being tested. If the outside of the crank pin is flat, or has been bruised, a small hole is drilled in its centre and a pin inserted which is allowed to

project one-eighth of an inch, in order that the indications of the pointer H may be more accurately observed. The shaft is now turned through one revolution, stopping at the two horizontal and vertical points at which the pointer H is brought in contact with the pin by the hand. The variations in those points of contact showing the direction in which the shaft requires moving to become true with the line of the cylinder and perfectly level. This test will be repeated when alterations are completed. The instrument can be applied in a short time, and arrangements being afterwards made for alterations little and in many cases no time is lost or stoppage required to keep the main working parts of the engine in their true working position.

QUESTIONS AND ANSWERS.

R. B. Emery, Guelph, asks what would be the cause of armature coils getting on fire, also what would be the effect on the dynamo if there were more lights on it than it was made for. Dynamos are running 300 incandescent lights each, thirteen hundred revolutions per minute, 16 candle power, 90 volts, and who is to blame for the accident.

Ans.:—Our friend appears from his letter to be either one of those sanguine people who think that nothing should ever happen to a dynamo, or honest-minded enough to believe the antiquated yarn of the agent who sold the machine that "our dynamos *never* burn out, it is only the other fellows'." It seems to us that if electric light men had flourished in the days of the late lamented Annanias there would be frequent and sudden vacancies in the selling staff of most concerns. However, the burning out of an armature coil is due to a short circuit in the coil which may be caused by a variety of means. There may be a particle of metal or copper dust between two adjacent segments of the commutator, or from want of cleanliness copper dust may have accumulated on the coil itself, or the dynamo may have been overloaded and the armature wire heated sufficiently to carbonize the cotton insulation of the wire. This would be liable to happen if the dynamo had many more lamps on circuit than it was originally intended to drive, or, as is more likely, the gradual process of decay that overtakes all things finite sooner or later, may have got in its work, and the frequent expansion and contraction caused by heating and cooling the armature have so disturbed the insulation as to produce contact between adjacent wires. As to where the blame should rest, we cannot say. If the dynamo has been properly attended to and kept clean and not seriously overloaded, our friend need not let his conscience disturb his slumbers, especially as he appears to possess the skill to repair the damage and get his machine again to work without delay.



A correspondent sends the above diagrams stating that they were taken from a Tandem compound engine which has no condenser and discharges the steam into the atmosphere.

Diagram A from one end of low pressure cylinder is peculiar. Our correspondent states that when there is a heavy load on the engine, there is no distortion of the diagram. It will be noticed that when the steam is expanded in diagram A, it falls below the atmospheric pressure but rises again immediately on the discharge of the steam commencing. He suggests that it is due to the admission of air; but why an admission of cold air into a cylinder containing steam at a pressure lower than the atmosphere should cause a sudden rise of pressure does not seem clear. Nor does it seem clear why it should remain at that pressure till the point H is reached and then suddenly drop to the normal line. A much more likely explanation is that there is a leakage of steam, either through the steam valve or past the piston, for part of the stroke. B and C are from the high pressure cylinder and there is nothing out of the way in them, nor anything to account for the peculiar shape of diagram A.

A correspondent asks the proper rule for determining the horse power of an engine and of a boiler.

The horse power of an engine is found by multiplying the area of the cylinder by the average pressure of steam on the piston, and by the number of feet travelled by the piston in one minute, and dividing the product by 33,000.

Example.—An engine with a cylinder 15″ diam. and 30″ stroke, makes 80 revolutions in a minute, the average pressure of steam on the piston is 19 lb. per sq. inch. What is the horse power?

The area of a cylinder 15″ in diameter is 176.71 sq. inches. The average pressure is 19 lbs., and the piston travels 400 feet in a minute. According to our rule, $176.71 \times 19 \times 400 \div 33{,}000 = 40$ 6-10 horse power. By increasing the steam pressure, the horse power may be increased. In determining the horse power it is usual to find the average pressure by means of an indicator diagram. If an engine of above size and speed were supplied with steam of 70 lbs. pressure, and cut off at ¼ stroke, the average pressure would be about 30 lbs. per sq. inch, and the horse power would then be 64 h. p.

The horse power of a boiler is not so easily determined. The term horse power applied to boilers has a totally different meaning from what it has when applied to an engine. The horse power of a boiler is measured by the amount of water it can turn into steam in an hour.

It used to be considered that a cubic foot of water made into steam in an hour was a horse power. In Canada and the United States at the present time, it is usually reckoned that 30 pounds weight of water of 100° temperature converted into steam of 70 lbs. pressure in one hour is a horse power. To determine the horse power of any given boiler is not easy because the amount of water evaporated depends upon the cleanness of the boiler, the setting, the draught and the fuel used. In a rough way it is often done by calculating the number of square feet of heating surface and allowing 12 to 15 sq. feet to the horse power.

A correspondent asks for a formula for the safe stress on shafting, also for breaking stress.

There are many different rules given for calculating the size of shafts or the safe load for any given shaft. Materials of which shafting is made vary so much in quality and the effect of bending combined with the torsion is so great, that a little difference in quality of metal or a little bending of the shaft may lead to the break down of a shaft, which, according to the rule, ought to be quite safe. The following is a sample of the rules given by writers on this subject and may be what our correspondent requires:—

Rule.—To determine the diameter of a pulley shaft of any material, multiply the force transmitted by the belt by the radius of the pulley, divide the product by the greatest safe shearing stress in pounds per square inch for the material of the shaft, extract the cube root of the quotient thus obtained, and multiply the result by 1.72.

To express the above rule in algebraic form and applicable to steel, wrought iron and cast iron

Let d = diameter of shaft in inches.

P = the total force applied to twist the shaft.

R = the distance from centre of shaft to point at which P acts.

The safe shearing stress for steel may be may be taken at 12,000 pounds per square inch, for wrought iron 8,000 pounds per square inch, and for cast iron 4,000 pounds.

Then for steel $d = 0.075 \sqrt[3]{P.R.}$

For wrought iron $d = 0.086 \sqrt[3]{P.R.}$

For cast iron $d = 0.108 \sqrt[3]{P.R.}$

The same rule may be used when the load is reckoned by horse power and the speed of the shaft in revolutions per minute is known.

Let H = horse power.

" N = number of revolutions per minute.

For steel $d = 2.984 \sqrt[3]{\frac{H^*}{N}}$

For wrought iron $d = 3.422 \sqrt[3]{\frac{H}{N}}$

For cast iron $d = 4.297 \sqrt[3]{\frac{H}{N}}$

An international Electrical Exhibition is to be held in St. Petersburg, Russia, beginning with the 1st of December, 1892, and to close on the 15th of March succeeding.

Mr. S. R. Parker, manager of the Owen Sound Electric Light Co., has just returned from a visit to Europe. He states the rate at which the electric companies in London are installing incandescent lamps is marvelous. The arc light, however, is employed but little. One cause of the popularity of incandescent lighting is the poor quality of London gas, the efficiency of which is described as about 16 or 17 candle power.

The Toronto Electric Light Co., owing to the increase of their business, find it necessary to enlarge their station. They are the owners of the water-lot immediately wess of their present premises, and they have decided to erect thereon another building equal in size to their present one, thereby doubling their capacity. Mr. J. J. Wright, the manager, is now making preparations to proceed with the work. Another chimney, 120 feet high and 12 feet square, will also be erected. Seven hundred horse power will be added to the present capacity of the steam plant. The dynamos, etc., required will be manufactursd in the company's own machine shop. The completion of these improvements will give the Toronto Electric Light Co. one of the largest and most complete central stations on this continent.

CROSS-TALK IN TELEPHONE LINES.*

In one of our earlier numbers we gave an account of Mr. Carty's experiments on the cause of cross-talk in telephone lines. Mr. Carty, as will be remembered, endeavored to prove that dynamic induction cannot be considered as the cause of the phenomenon, but that cross-talk is due to electrostatic effects. The results of these experiments clearly prove that static induction plays an important part in producing distorting effects, and even, under certain conditions, may be considered as their only cause. An attentive observer, however, of the working of various telephone lines will notice certain facts leading to the conclusion that static induction is not the main cause of cross-talk. It is generally known that in lines fastened to wooden poles the disturbances are strongest in very dry weather, and that when rain begins to fall, even very slightly, these effects are suddenly diminished, even to a very considerable extent. According to Carty's theory, the very reverse ought to take place, for through the moistening of the insulators the conducting surface, and with it the capacity, is increased.

A further contradiction will be found in the following consideration: Whilst cross-talk is already clearly perceptible in lines of one kilometre length, fastened to wooden poles, not a trace of these effects can be noticed in urban lines of equal length fastened to iron poles. Now, the charge of the former lines amounts to about 0.1 microfarad, while in urban lines, owing to the closer grouping of the wires, the capacity rises to .1 microfarad. Another factor must, therefore, come into play to produce cross-talk, and the factor is, according to Mr. Müller, the direct leakage of current from one line over the insulators to another line. The case is illustrated in Fig. 1.

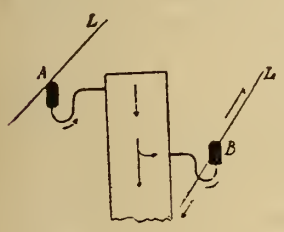


FIG. 1.

From the line L, at the insulator A, part of the current will pass into the pole to be further split up at the support of insulator B. One portion goes to earth along the pole, while the other portion reaches line L′ over the insulator B and thence flows off in both directions. The conditions of resistance of these two current paths influence in a great measure the amount of cross-talk, and explain the apparent contradiction of the preceding remarks. In very dry weather the resistance of the current path along the pole to earth is very large. It is true that the resistance of the current of the current path of the leakage current over the insulators *a* from one line to the other is also very large, but a relatively large portion of the current escaping from L will reach L′, and will there go to earth at both ends.

If, now, the pole is moistened by rain it forms a good earth shunt, and only allows the smallest possible fraction of the leakage current to pass from L to L′. This fraction is the smaller the better the shunt from the pole to earth. The iron poles on the roofs of houses are, as is well known, carefully jointed to especially good earth connections.

On considering the current path in two parallel telephone lines, it will be found that a neutral point must exist in the line.

If the state of insulation is quite uniform, there must exist for each point of support another point of support at the other end of the line where the currents are equal. In the same way, at two other points the currents will be equal. These currents, therefore, neutralize each other, and there must exist, almost in the middle of the line, a spot which remains with current, and where no cross-talk is perceptible.

The author remarks, at the same time, that more than six years ago he expressed an opinion on the existence of a neutral point near the middle of the line, but was unable to prove the correctness of his view from want of the necessary apparatus.

From the above remarks we are led to the conclusion that, although static induction play an important part in cross-talk, yet to diminish these effects the best possible insulation and the most intimate possible connection between the insulator support and earth must be provided. When using wooden poles a special wire rope for earth connection will have to be supplied. If this rope is to fulfil its purpose, it must not terminate in the hole dug for the reception of the pole, but it must extend as far as the underground water.

* By E. Muller in *Electrotechnische Zeitschrift.*

THE NATURE OF ELECTRICITY.

By Alexander Jay Wurts.

"Electric current" and "electric fluid" are convenient terms used to express a certain condition of matter, but their use is misleading, in that they imply a flowing motion of some material thing. They are expressions which, in the early days of electricity, appealed readily to the imagination, and were consequently adopted by common consent. They are now used because they are in use, and because they express what seems to take place. They are used for the same reason that the "setting sun" is used.

An electric current has direction without without any flow or transmission of matter. To illustrate: Imagine a horizontal brass rod with a lamp under one end. First, the rod becomes hot directly over the lamp, then further and further away, and we say that the heat "creeps" over the rod. If the rod had been previously coated with wax, the wax would gradually melt from one end toward the other. In this illustration the heat is guided by the conducting properties of the rod, and it therefore had a direction along its length; but there is no transmission of matter—no flow of a tangible substance. In other words, heat is not a material thing. It is a kind of motion—a motion of molecules or body particles—and being a motion, it is a form of energy. When this energy is transmitted from one place to another we notice the direction, and say that it "flows." Electricity is also a form of energy, and when this form of energy is transmitted over a wire there is direction without transmission of matter.

The latest researches indicate that heat is a motion of the particles of which matter is supposed to be constructed. It must not be understood here that heat causes this motion, or that the motion causes the heat. It is the motion itself that has been given the name of heat. It is heat motion. Expansion due to heat is then explained in this way. A pendulum vibrating with a given amplitude may be said to correspond to a given temperature. If the temperature is increased, the motion—that is, the amplitude of vibration—will be correspondingly increased, and consequently more room (expansion) will be required for this increased motion. If we imagine a mass of marbles, each marble moving and vibrating with respect to the mass, and never touching its neighbor, much as the heavenly bodies move and vibrate with respect to the universe, and then imagine further that by some outside influence those marbles are caused to move more rapidly, this is, with an increased amplitude of vibration, it will be easy to understand that they must have more room—"elbow room," so to speak. In steam we have an excellent example of expansion due to heat, in that the molecules are by their own motion driven so far apart that their mass becomes invisible. If we could magnify the molecules to such an extent as to make them visible, steam would look something like the universe with its worlds and interplanetary spaces.

Heat motion is transmitted from one particle to another by the influence of such particles on each other. If we stand a number of blocks on end and in a zigzag direction across the floor, in such a way that when the end block is tipped over it will cause all the others to fall in succession, it will be easy to understand how that motion, that is energy, can be transmitted and guided in its direction by the effect of one particle on another without actual transmission of matter. The connecting link between the above remarks and electricity is this: Heat is one form of molecular energy and electricity is another. Energy, in its broadest sense, is a condition of matter having the power to do work. A moving train, a lifted weight, gunpowder, compressed air, etc., etc., are all forms of energy. Energy is a universal characteristic of matter. Its natural form is that of vibratory motion without transmission of matter. If we start a pendulum vibrating, it will tend to vibrate forever, but friction forces it to come to rest. If we could drop a stone through the centre of the earth, the stone would vibrate back and forth forever, were it not for friction. The heavenly bodies, meeting with no friction and having been once set in motion, move forever. It is their natural state, and their motion is vibratory. —*The Phonogram.*

It is highly desirable that the regular pressure guage be supplemented by a recording gauge.—Robert Grimshaw's Hints to Power Users.

THE ELECTRIC TRANSMISSION OF POWER.

By Gisbert Kapp.

(Continued from December Number.)

Now let us see how such a system of transmission will have to be worked, and what the working expenses will be. I take, by way of example, five miles as the distance between the generating station, which may be the tramway depôt or a central electric light station on the line of tramway, and the delivery station. At either terminus we must have mechanical appliances for loading and unloading the batteries from the car, such as are generally used in connection with storage cars. Early in the morning a charged battery is put on the car, and run out to the delivery station, where it is unloaded and connected to the motor. The other battery, which has served during the previous day, is loaded on the car and taken back to the depôt to be charged up again. In this manner the car need only make one journey out and one journey home daily. As its speed may be very moderate, say from three to four miles an hour, the cost of running this car will be much less than that of a passenger car, which must stop and start every few minutes, and run at a higher speed. I take 3d. per car mile as the cost of haulage, including the use of plant, and I further allow 2s. a day for labour in loading and unloading the batteries. The account of working expenses will now stand somewhat as follows :—

	£	s.	d.
Power at generating station at £10, allowing 65 per cent. total efficiency*	77	0	0
Haulage	37	10	0
Labour	30	0	0
15 per cent. interest and depreciation on batteries (£340)	51	0	0
10 per cent. interest and depreciation on electric machinery (£150)	15	0	0
Total annual cost	£210	10	0

This works out at £42. 2s. per annum per horse-power delivered, and is therefore quite as high, if not higher, than the cost of power obtained by a small and uneconomical local engine. On the score of economy there is consequently no advantage in transmitting power by storage batteries in the present case, where the distance of transmission is five miles. Had the distance been less, the working expenses would also have come out smaller, but not by any considerable amount. The only item in which we could save is cost of haulage, and if we neglect this altogether we have still to pay £34. 12s. per annual h. p. delivered. Battery transmission can therefore not compete against power produced by a local engine, even if the latter be of the rather uneconomical type which users of small power still tolerate. But how stands the case if for some local reason the employment of a heat-engine of any kind is precluded? We have, then, the choice between electric transmission by means of batteries, and directly by means of a pair of wires. Which will be the more economical? As the dynamo and motor, except, perhaps, in the matter of voltage, will be the same in either case, the answer to this question turns upon the comparison of the batteries and line of wires. The first question to consider is whether our wires may, in the case of direct transmission, be carried overhead on poles and insulators, or must be put underground. If the former be the case, the line need not cost more than £130 per mile ; and I may at once mention that, from the experience gained with various power transmissions, which I hope to bring before you, this item can be estimated with a fair degree of accuracy. As I shall have to deal more in detail with the cost and construction of live power transmission plants later on, I shall not enter into details at present, and must ask you to take my statements as to cost of line and cost of power transmitted as correct, though I do not now show how the account is made up. As regards transmission by wires placed underground, there is, as far as I know, no example of such an installation, and we can, therefore, not verify our estimate by reference to work actually executed, as we can in the case of overhead transmission. We are thus forced to calculate the cost of the line according to the data obtainable for electric light mains, and I take for this purpose an estimate made by Mr. Crompton in his paper on "Central Station Lighting," read before the Institution of Electrical Engineers, on the 12th of April, 1888. In this paper Mr. Crompton gave tables for the cost of underground mains of various types and sizes, and by reference to his tables I find that a main of the section required for the transmission of 5 h. p., and insulated so as to safely bear a pressure of 1,000 volts, would cost about £670 per mile. We have now all the necessary particulars for making a comparison of the cost of battery transmission and direct transmission, the latter by both overhead and underground wires. The following table gives the result. The cost includes the charge for power at the generating station (taken at £10 per annual h. p.), and interest and depreciation on the plant, which is taken at 15 per cent. for the batteries, and 10 per cent. for the line and electrical machinery.

Transmission plant for 5 H. P.

Distance of transmission in miles.	Annual cost per h. p. delivered, if transmission is		
	By batteries.	Direct.	
		Overhead.	Underground.
1	£36·1	£22·8	£33·6
2	39·1	25·6	47·2
3	37·9	28	60
4	40·6	30·6	74
5	42·1	33	87

We see from this table that if there is no objection to an overhead line, the electric transmission of stored power by means of batteries cannot compete against the direct transmission of live power by means of a pair of wires, even if the distance is considerable. But in towns we cannot have, or at least we ought not tolerate, overhead lines, and if we work with an underground line we find that, for distances exceeding one mile, the battery is a more economical transmitting agent than the wire. Here we have at last found a case where it will be advantageous to transmit power by means of storage batteries, but there are so many conditions attached to the case that the field of application of such a system must necessarily remain very limited. First, the power must be required, so to say, in small parcels ; secondly, there must be a tram line handy, and the customer must have facilities for loading and unloading the batteries and accommodating them on his premises ; thirdly, there must be a charging station on the line having similar facilities : fourthly, the use of an overhead line must be excluded ; fifthly, the distance must exceed one mile ; and, finally, there must be some reason why a local engine cannot be used. I need hardly point out that a system of transmission fenced in by so many conditions cannot have any commercial importance. Thus far, the result of our investigation is entirely negative. We find that transmission of power by means of storage batteries, whether the power transmitted be large or small, is not so economical as other methods of transmission, and has, therefore, no commercial value for all cases where these other methods are applicable. If I have, nevertheless, devoted some part of this lecture to the subject of battery transmission, it was because the idea of distributing power, so to speak, bottled up in batteries, seems to have a fatal charm for many inventors. It is an old idea, but is always coming up again, and for this reason I thought it advisable to go a little into figures and show you how the case really stands. It might perhaps be objected that as no distribution of stored power by means of ambulant batteries has as yet been practically introduced, it is premature to give an opinion as to the possibilities of such a system. The idea of battery distribution of power is, as a matter of fact, entertained not only by amateur electricians, but also by practical engineers. As an example of this fact, I may quote a passage in a report written about two years ago by Mr. J. F. Fanning. This gentleman, reporting to the Cataract Construction Company on the question of utilizing the power of Niagara Falls, says :— "Power and lighting currents may be electrically transmitted to neighboring cities, and possibly storage batteries may be electrically charged and re-charged, and many times forwarded for use in surrounding cities." When writing this, Mr. Fanning had, of course, in view cheap water-power, and probably canal transportation. If, at the same time, batteries could be made cheaper, lighter, and more durable than they actually are at present, then, but not until then, will they become commercially possible as transmitting agents in competition with other

* In this case, the efficiency is the ratio of the power supplied to the charging dynamo to that obtained from the motor, and does not include power spent in transmission being charged for in the account at 3d. per car mile.

systems of power transmission. Taking batteries as we find them at present their use as agent in the transmission of power is only justifiable in cases where the direct transmission by means of conductors cannot be employed ; and this brings me to the consideration of the only case of the electric transmission of stored power which as yet has attained to practical importance —namely, the use of batteries for locomotive purpose.

Although electric tram-cars come, strictly speaking, within the title of my lectures, I do not propose to consider them at any length, the reason being that this branch of power transmission alone, if treated in detail, would absorb all the time at my disposal. I shall, therefore, content myself in taking up the subject only so far as is necessary to show in a general way what is the present practice in this branch of power transmission.

We have in this country two very good examples of battery tram-cars, the one being the cars now running in Birmingham, and the other the cars on the Barking-road line in the North of London. Of the former I have not been able to obtain much information, but of the latter I have by the kindness of Mr. Thomas Fraser, who superintended the erection and working of the plant, been able to obtain all the information required for my purpose. I am also indebted to Mr. Reckenzaun for information regarding his cars, which are in use at Philadelphia. The following table gives the principal data of these cars, conveniently arranged for comparison and reference.

Taking the average of the last two lines in the table, we find that for a car representing a total rolling weight of 10 tons, we require a battery capable of giving a maximum output at its terminals of 19 E. H. P., and a mean output of 5·6 E. H. P. It must, however, be noted that the latter figure applies to the time the car is actually in motion, and does not include the power wasted in starting. Mr. Fraser has made very careful observations of the power flowing out of the batteries during the whole of the time the car is in service, and found that the integrated power divided by time came to 7·33 E. H. P. ; that is to say, a motor taking from the batteries all day long 7·33 E. H. P. will take from the batteries the same amount of power that is actually taken under the intermittent work going on in the running of a tram-car. Of the 7·33 E. H. P. a good motor will yield about 6½ E. H. P. Taking the efficiency of the batteries at 60 per cent., a figure by no means too low when we consider the very irregular nature of the work done by these batteries when in service, we find that the E. H. P. of the charging dynamos required per car is about 12 E. H. P. The ratio between the indicated power of the engine and the output of the charging dynamo may be taken at 80 per cent., so that we shall have to provide engine-power at the rate of 15 I. H. P. for every car, provided the engines are worked for the same number of hours that the cars are in service. If the engines are worked for a longer time, say by night as well as by day, a corresponding reduction in the total indicated power of the station can, of course, be made.

Storage Battery Tram-Cars.

	Birmingham.	Barking-road.	Philadelphia.	
			Small car.	Large car
Weight of car (in tons)	——	3.275	2.500	3.620
" motors gear (in tons)	——	1.360	.980	1.140
" batteries (in tons)	2.850	2.400	1.770	2.450
" passengers (in tons)	3.300	3.600	2.230	3.600
Total rolling weight (in tons)	10.50	10.63	7.48	10.81
Percentage of paying load	31.5	34	30	33.2
Number of cells	96	96	84	116
Maximum current	——	70	70	80
Maximum energy at battery terminals (E.H.P.)	——	19	14	23
Average energy at battery terminals (E.H.P.)	——	6	4.8	5.4
Maximum energy per 10 tons of rolling weight (E.H.P.)	——	17.8	18.7	21.3
Average energy per 10 tons of rolling weight (E.H.P.)	——	5.65	6.42	4.95

Returning now to the subject of the cost at which stored power can be retailed by electric transmission to small consumers, let us briefly glance at the rival system, namely, the distribution of small parcels of live power from a central electric light station. One hears it often stated that the supply of power, and not that of light, must become the chief business of such stations. The argument in support of this view is somewhat as follows :—The demand for light is very uneven, being less than a tenth of the capacity of the station for many hours during the day, and rising very rapidly towards evening. The period of large demand comprises only a few hours, and during that time the engines work, with great economy. During the remainder of the day the economy is less ; and, in fact, the greater portion of the coal bill, cost of attendance, and interest on the capital outlay is chargeable to light running. If, therefore, by the sale of power, we could keep the central station plant economically working during the whole of the day, the increase of the working expenses would be slight, but the increase of revenue would be very considerable. This argument is perfectly sound, but it has the rather serious defect that it will not convince the very people from whom this large increase of revenue is to be obtained ; for, let us see what it means to the use of power. As you know, electric current is supplied from central stations, at a charge varying from 4½d. to 8d., and even 1s. per Board of Trade unit. The usual charge in London is about 7d.

Now, suppose a small manufacturer, requiring only a few horse-power, determines to discard his small steam or gas engine, and put up an electro-motor, to be worked by current from a central station, what will the power cost him ? This, of course, depends on the time—that is, the number of hours in the year during which he requires power. If he has a small factory, in which work is steadily going on, day by day, you may estimate that the power will be required during 300 hours per annum. It is now very easy to calculate the annual cost of each brake horse-power. Allowing £1 10s. per horse-power for depreciation and interest on the motor, and £1 for petty stores, we find that, at 7d. per unit, the annual horse-power will be accordingly altered, as shown in the table:—

Power Derived from a Central Station.

Cost of Board of Trade unit	d. 1	d. 2	d. 3	d. 4	d. 5	d. 6	d. 7	d. 8
Cost of annual brake horse-power for 3,000 hours	£ 12.9	£ 23.3	£ 33.5	£ 43.9	£ 54.2	£ 64.5	£ 75	£ 8.54

It is clear, from this table, that the small user of power will only use an electromotor if he can get current at about 3d. per unit, and, unless electric light companies can supply at this price (which at the present time does not seem likely) there is no prospect of supplying electric power to small factories wanting the power continuously. Another disadvantage is that the demand for power must, in winter at any rate, overlap the demand for light, thus requiring the erection of additional plant. If, however, the power is only required intermittently, then the electromotor is by far the cheapest instrument for producing it, not only as regards first cost, but also as regards working expenses. There are many small trades in which power is wanted only for a few hours during the day. If, for instance, the actual running time of a lathe is two hours daily, then the cost of the annual horse-power with current at 7d. would only be £15, a figure which cannot be touched by either steam or gas. There is the further advantage of having the power always ready. There is no need to get up steam, look to the feed pump, open cylinder cocks, turn the engine over the centre, and generally do the dozen little things which are required in starting an engine. With a motor all that is required is to turn on the switch when the power is wanted, and to turn it off again when the job is done. For domestic purposes again, nothing could be more handy and economical than electric power supplied from a central station. I have here a collection of appliances, for the loan of which I have to thank the Keys Electric Company, and I can show you how easy and convenient it is to apply electric power to small domestic machinery.

I have in the present lecture dealt with what may be termed general questions of engineering policy rather than with technical details, and I am afraid you will have found the financial parts of the lecture rather a dry subject. The question of cost is, however, of the utmost importance in engineering work, and it was, therefore, necessary to give it some consideration. In the remaining two lectures I shall be able to turn to the more interesting parts of our subject, and bring before you some of the scientific principles and technical details relating to the electric transmission of live power of long and short distances.

(To be Continued.)

DYNAMO ROOM TALKS.

I HAVE seen instruments called voltmeters of such low resistance as to materially change the potential difference of the circuit on which they were used. This will be the case where the supply of current is small and the resistance of the instrument low. The effect is always present to a more or less degree, and when making accurate laboratory tests is taken into account, but in practice, with the fall of potential due to the introduction of the voltmeter into circuit is too slight to be noticed or to be of any appreciable value.

A good dynamo room test for a voltmeter, where a galvanometer is not handy with which its exact resistance may be measured, is to connect in series with the voltmeter an ordinary 110 volt lamp. If the lamp colors the least in a dark room when in circuit with the voltmeter, the instrument is of too low resistance to be used. I do not mean by this that an instrument which will stand this test has sufficiently high resistance, but I mean that one which will not stand this should not be used at all.

A voltmeter is placed in circuit in such a way that it abstracts a small portion of the current, so that the higher the resistance of the voltmeter the smaller proportion of current will pass through it. With a very delicate, sensitive instrument only a small portion will be necessary to move the indicator hand. In practice I should say that not more than three to five watts should be allowed for any voltmeter or ampere meter.

An ampere meter is an instrument for measuring the current, and it is placed in circuit in series, so that the entire current it is desired to measure passes through it. It will therefore be readily understood that it should not form any considerable portion of the resistance of the circuit. An ampere multiplied by a volt equals one watt and it requires 746 watts to equal one horse power or 33,000 foot pounds.

You will understand that a current cannot pass through any conductor without losing a portion of its energy ; just as water flowing though a pipe loses some of its energy by friction. This loss is easily ascertained in hydraulics ; it is just as easily found in the case of electricity. There is no perfect conductors of electricity. There are no conductors over which a current passes but what offer some resistance, and to overcome this resistance we must lose a portion of our electrical energy. We must therefore make the resistance of our ampere meter as low as possible, so that our loss may be reduced to a minimum. The resistance of the ampere meter multiplied by the square of the current flowing through it equals the number of watts lost. An ammeter for station use should be provided with a short circuiting plug or switch, and occasionally it may be used to test the instruments. This is especially needed where your load is practically constant, as in some stations having approximately a definite number of lights on for a given time. Then the switch may be used to see that the pointer will always return to the same position. On railroad circuits, ammeters are usually kept busy and will not require this test. An ammeter in circuit with every feeder will enable you to quickly locate grounds, and an ammeter in circuit with the buss bars will show at all times the total current going to line, and it gives you a ready means for checking against feeder ammeters. In this way any derangement of any of the instruments may be quickly noticed.

Before leaving the subject of instruments, did you ever see a steam guage on a boiler that did not have an oil lamp, gas flame or incandescent lamp near it, so that the face of the gauge was always plainly in view ? On the other hand, did you ever see an incandescent lamp properly placed in front of the instrument, or on an electric switchboard ? In front and just above each instrument, secure a goose-neck bracket, and let the lamp drop down so that it will fall just in front of the instrument ; now get one of these mirror reflections and place it in front of the lamp so you may be able to see the instrument, without being blinded. A piece of tin foil pasted on one side of an ordinary lamp will answer. Take the cluster of lamps off of your switchboard, where they have so admirably shaded your instruments, and place them in the goose-neck holders before your instrument and do not stick lamps around on top of your dynamo, where they constantly shine in your eyes. Drop them down from the ceiling or put them on fixtures 8 to 10 inches above your eyes.

It is handy to have a lamp drop from the ceiling just above each dynamo, so that an extension cord may be connected into the socket. When it is necessary to examine or clean a dynamo, a lamp may in this manner be used to examine every portion of the machine.

Safety catches, plugs, fuses, or by the name of soft strips, they are all the same. It is an attempt to provide a safety valve for an electric circuit. The device is a small insignificant thing. It would be overlooked by a casual observer, and I am afraid does not receive enough attention from those whose duty it is to look after them. Without discussing the question here as to whether they are the *ne plus ultra* for the purpose intended, we must content ourselves with the fact that they are the most approved safety guard we have at the present time, and in order to get fairly good or reliable results from them, we must know something about them and must recognize them as one of the most essential factors to the operation of our plant.

I have just read a recent book treating on the subject of electric plants, apparatus, etc., and how to take care of them, and I find that it does not contain a single reference to safety catches. The author thought, probably, that they were so small and insignificant that they did not deserve attention. He evidently believes in "big things," however, for he has a picture in his book of every type of dynamo within the record of the Patent Office. Our thoughts are for those who are sufficiently well informed to distinguish the various types of dynamos, without the necessity of having the much worn electrotypes of them brought into requisition here, and having us say like Blenkarn, "this is a teapot." I have my own ideas about the best model and devices to be used for safety catches, but "that is another story."

A safety catch or fuse wire, as we find it in the market, is simply an alloy of lead and tin, but if we are to believe the makers, it is compounded in secret by a high priced man, who discovered the art after many, many years of careful study, and the secret is known only to the particular maker advertising the ware. But the truth of the matter is, that this difficult problem is solved in the following simple manner by the supply houses : The stockman discovers that his supply of the precious and very expensive metal is running low ; he writes out an order on some prominent metallurgist or metal man which reads as follows :— "— pounds assorted sizes half-and-half wire solder." The office boy then winds this solder on small fancy tin spools with gaudy printed labels pasted on the ends, it is graded by the use of a printed table, the author of which is not known, and probably would be regarded less if he were, and a rusty wire guage ; it is then put on the shelf and is ready for the unwary, at prices 300 to 500 per cent. above cost.

So much for the commercial aspect ; now let us see what we had better do with this delinquent. The best suggestion I can offer is, do not become one of the victims. How can it be avoided ? I will tell you. Don't you buy half-and-half solder nor other alloy. Instead, select a metal man in whom you have confidence, and next month we will tell you how to procure a fuse that you will find much more reliable than those to which you have been accustomed.—Force Bain in *Electrical Industries.*

PUBLICATIONS.

We have received from the Waterous Engine Works Co., of Brantford, a catalogue and price list of their "Friction Grip Pulleys," containing references from a number of well-known firms who have these pulleys in use.

The publishers of the *Monetary Times*, Toronto, have issued a very neat and useful souvenir in the shape of a vest pocket slate. The *Monetary Times* has reached the 25th year of its publication and has our best wishes for a prolonged and increasingly useful career in the future.

The January *Arena* contains strong papers by Alfred Russel Wallace on "Human Progress : Past and Future"; Prof. A. N. Jannaris, Ph. D., of the University of Greece, Athens, on "Mohammedan Marriage and Life"; Henry Wood, on "The University of Law"; Ex-Gov. Lionel A. Sheldon, on "Louisiana and the Levees"; D. G. Watts, on "Walt Whitman"; Chas. Schroder, on "What is Buddhism?" and several other able papers. The *Arena* fully maintains its brilliant reputation and should be in the homes of all thoughtful people.

The Great Northwestern Telegraph Co. brought a suit against the Montreal Telegraph Co., whose lines it leased in 1881, for a loss of $80,000 per year alleged to have been sustained by reason of the competition from the Canadian Pacific Telegraph Company over exclusively Montreal Telegraph Company territory, which it claimed it was the duty of the Montreal Telegraph Company to prevent. The Supreme Court at Ottawa has just given its decision, which is in favor of the Montreal Telegraph Company.

STEAM BOILER FITTINGS.

SAVETY valves should be large enough to discharge all the steam the boiler can make without undue increase of pressure. Where pop safety valves are used, it is better to have two smaller ones rather than one large one. A good arrangement is to have one small pop valve and a larger valve of the ordinary kind loaded by a lever and weight. The large valve should be loaded to open only when the small pop valve proved insufficient to keep down the pressure.

Safety valves should be tried every day by slowly raising them a little from their seats. It is a good plan to try them occasionally by allowing the steam to raise them. If the valves are found to be fast to their seats, steam should be let down as soon as possible and the valves opened and taken out and cleaned and oiled. It is dangerous to attempt to relieve a valve that is stuck very fast while the pressure is on. Cases have occurred where the valve has suddenly left its seat and been blown with such violence as to break its chest and kill the man who was foolish enough to try to free it.

Safety valves that leak are sometimes made tight by hanging a chain or a poker on the end of the lever. This is a back-woods method of saving steam that has been the true cause of many boiler explosions. If the safety valve cannot be made to fit its seat and keep tight when shut, and open at the proper pressure, there is something wrong with the valve. Frequently it is caused by the valve being made of too thin metal, and when the weight bears upon it, it yields and gets out of proper shape. The only remedy is to break it up and get a stronger one.

Sometimes pieces of grit or boiler scale will catch on the valve seat when steam is blowing off and cut the metal. In this case, the valve and seat should be ground together with a little fine emery powder and oil, until a good bearing is again obtained. Care should be taken to finish the grinding in such a way as to get all the powder worked out; and it is better to have the water in the boiler hot when it is being done, so that the valve and its seat may be as nearly as possible at the same temperature as they will be when steam is up.

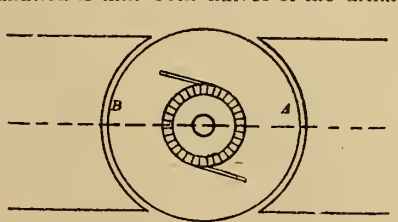
A SIMPLE METHOD OF LOCATING ARMATURE DEFECTS.

BY OSBORN P. LOOMIS.

ALL electricians are aware of the many trials of searching for an armature "short-circuit." One method is to run the armature by the usual belting and excite the field; then by observing the heated parts some idea may be obtained where to commence searching for the trouble. It will be understood that the above will only apply to the short-circuiting of a few coils, for when the whole, or nearly the whole, armature is closed on itself by the two adjacent wires touching, running in an excited field will warm all the wires and, of course, no locating is possible. To add to the trouble, the machine must be belted up and run, which takes time, and repeated trials become very annoying.

I will now describe a method, devised by the writer, which at times has been very convenient. No arrangement for belting need be made; it is only necessary to fasten a monkey-wrench to the rim of the pulley, or, better still, a crank to the end of the shaft. Now excite the fields and, to make the effects more marked, connect the coils in parallel as the excessive current will only be used for a moment. When this has been done the strongest man will scarcely be able to rotate the armature, and then only with extreme slowness, except at one position. When this position has been found, mark the armature at points in the centre of the pole-pieces A, B, as shown in the accompanying diagram, and at both ends of the armature.

The explanation is that both halves of the armature oppose



one another at this position; but when not at these points a continuous circuit is formed and the resultant magnetic effect is enormous. As the "cross" will be found at one of these four marked points it becomes desirable to know in which one it is most likely to be found. Experience has shown that it is nearly always on the commutator end in the last half of the winding where the wires pass down through the first half terminals. In armatures where the windings are equal, I suppose it would be as liable to be at one point as at another.

With this method a defect can be found and remedied in a few moments, for it has always been a simple matter to repair it when discovered. These results can be observed in a perfect armature by connecting the opposite sections of the commutator. When only one coil is short-circuited, the magnetic effect is much less and the points must be marked 90° from the ones shown, but these cases are few and are soon discovered in other ways. The above will be understood to apply to armatures of the drum type with Siemens winding.—N. Y. *Electrical Engineer.*

THE NEW "W. P." MOTOR.

VISITORS to the recent Street Railway Convention at Pittsburgh will recall a motor in the Thomson-Houston exhibits of apparatus called "W. P." and described as designed for narrow guage service. Its history will prove particularly interesting to the street railway fraternity.

During the last spring the Thomson-Houston company, at their works in Lynn, began the development of a motor especially designed for narrow guage service. As the machine grew, there were incorporated into it many improvements suggested by experience with various types and the demands of railway service. The lessons of the preceding winter were particularly kept in mind and applied. The electrical parts of the new motor were so carefully protected from mechanical injury, snow and water, that the machine took its name from this feature and was called the "W. P." or "water proof." The single reduction motor (known generally as "S. R. G.") that has been largely sold during the current year is also practically water proof, a separate casing being used to protect the condition.

When the "W. P." went into service on narrow guage roads its many improvements and its excellence created, to an extent, a demand for it on roads of standard guage. In response to this call a few machines were sent out and their record has been so satisfactory that the company have concluded to adopt and recommend the "W. P." as one of their regular single reduction motors for general railway service.

Among the railway companies that have tested the "W. P." motor is the West End Company, of Boston, and it is a striking evidence of the confidence which this motor has created that the Thomson-Houston company have received an order for 500 of these machines in further equipment of the West End system. The machine ordered by the West End company is very conservatively rated at twenty-five h. p. The other standard size at fifteen h. p.

The motor frame consists of two castings of steel clamped together by bolts at the back and front, the axle brasses being held between the two parts. The armature bearings are cast in one piece with the lower half of the frame, and are provided with caps so that the linings may be inspected or renewed without disturbing other parts of the machine. The lower half is shaped somewhat like a bowl, rounding up from a plough-shaped bottom, which will throw aside stones or other obstructions which may be on the track. The upper half meets the lower, except upon the armature bearings, where holes are left for access to bearings and commutator and for ventilation. Only one field spool is used, which surrounds the armature and upper pole piece, and is itself completely covered by the frame.

A remarkable feature of this machine is the fact that it is so proportioned that at its normal load the solenoidal pull of the field is sufficient to lift the armature and relieve the bearings of the weight. There will, therefore, under ordinary conditions be no tendency to hot bearings.

The motor can be run in water up to the axle—in fact, can be left standing in it without damage; and water dripping on it from above is shed off without gaining the interior of the motor. It will then be seen that the armature, field spool, commutator and brushes are completely inclosed in the frame. The parts of the frame are hinged together at the axle end. By removing four bolts, therefore, the upper half may be swung upward, or the lower half downward through a trap in the car floor or into a pit under the track, as may be convenient. The armature or field spool may then be easily removed.

Not only is the motor, as a whole, ironclad, but the armature is also ironclad. The core is a ring with projecting teeth of a peculiar form. The coils are wound between the teeth and held firmly in place by wooden wedges. No binding wire is used, and to replace a coil it is only necessary to drive out a wedge and the coil can be rewound without disturbing the rest of the winding. The importance of this feature will be appreciated by those who have had to repair drum armatures. The winding is continuous; joints in the wire, where necessary, are electrically welded, no solder whatever being used. This construction protects the armature winding from mechanical injury as it is below the surface of the iron core. Electrically, a decided advantage is gained because the air gap can be made very small. This permits of comparatively few turns of wire being used to excite the field and consequently requires but a short magnetic circuit. Practically all the metal in the machine is used in the magnetic circuit, thus making the weight of both iron and copper small, while the efficiency of the motor is very high. The brush holders are mounted in a groove planed in the frame alongside of the armature bearing. By giving a quarter turn to a handle on the brush holder, it may be taken from the motor to examine or renew a brush. The convenience of such an arrangement is obvious, as it obviates the necessity of reaching down into the motor and handling a brush which possibly is hot. The armature shaft has been made short and heavy to avoid the possibility of springing, and is fitted with steel shells, thus ensuring a proper bearing at all times. In case of wear from long use or scoring from grit, these shells can be replaced. The linings of the boxes are of punched sheet metal just thick enough to stand the wear required of them, and when thrown away waste little metal. The gears are of steel and are run in a case filled with oil. This case is split in halves and has a hinged cover through which the gears may be inspected and oil introduced. By loosening the nuts on two hinged bolts a section of this case can be removed and the pinion on the armature shaft drawn off without taking apart the gear case proper. The small size of this motor permits two of them to be mounted on a track of five feet wheel base and three feet guage.

These motors have not only been thoroughly tested at the works of the company, but have been in regular service on several roads. They have proved themselves to be highly efficient and able to stand the roughest usage without injury.

The Canadian Electrical Association wants your name on its membership roll, and your active co-operation in behalf of the welfare and development of Canadian electrical interests.

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Subscribers may have the mailing address changed as often as desired. *When ordering change, always give the old as well as the new address.*

The Publisher should be notified of the failure of subscribers to receive their papers promptly and regularly.

EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

VOLUME II.

THE CANADIAN ELECTRICAL NEWS celebrates its first anniversary. It has successfully passed the critical period of early infancy, and hopes to continue its development, side by side with the important interests which it seeks to serve, throughout many future years.

Thanks are hereby extended to every person who contributed in any degree to the success of the first year's effort. A continuance of their support would be much appreciated, while those who may not have lent their assistance are invited to do so in the future.

It is gratifying to observe that some subscribers are complying with the invitation to ask questions. It is the privilege of every subscriber to receive direct benefit to himself in this way, as well as to assist in making the paper increasingly valuable to every reader.

Suggestions from subscribers concerning means of making the paper better serve the wants of its readers, will always be welcomed and carefully considered.

It has been thought desirable to make a change in the cover of the paper, which it is hoped will meet with the approval of its readers and display to better advantage the announcements of advertisers.

With the kind assistance of its readers, the ELECTRICAL NEWS will doubtless be able to again report progress when it reaches its second anniversary.

May 1892 bring to all prosperity.

A MEMBER of a prominent Toronto firm who was recently visiting Canada after a residence of twelve years in England, said the general use of telephone and electric light in this country was a revelation to him. There are, he said, more telephones in use in Toronto than in London, England.

CARLETON Place, Ont., is the proud possessor of an "electric girl." Her name is Miss Abbott. If published accounts of her doings are to be relied on, her voltage is enormous. An angry bull which rushed at her she is said to have literally taken by the horns and tossed aside, notwithstanding his weight was 1,900 pounds. The animal evidently mistook Miss Abbot for the ordinary kind of girl, and has probably not yet recovered from his surprise. The Canadian girl has long been noted for her magnetism, and now that to this she has added electric power, she becomes simply irresistible.

THE Executive Committee of the Citizens' Committee, under whose direction the members of the National Electric Light Association spent a week of huge enjoyment at the Montreal Convention in September, are not yet quit of the responsibilities of office. The settlement of accounts is now in order, and rumor has it that some of the bills rendered are regarded with more than a trifle of astonishment. This is not an unusual experience in connection with affairs of this kind. A good rule would be to recognize only such expenditures as were authorized by the Executive Committee. If any gentlemen, acting in their individual capacity, succeeded in winning widespread fame by their display of princely hospitality, they will no doubt consider it a privilege to pay the price of the honors out of their own pockets, and be especially grateful for the privilege when they consider how seldom opportunities for achieving sudden distinction present themselves.

The office of the Secretary of the Canadian Electrical Association is at No. 14 King St. West, Toronto, to which address applications for membership and all communications relating to the Association should be addressed.

AN amusing episode occurred in Mr. Justice Ferguson's court during a recent trial of an electric light case. It was probably the first time that electricity has played any part in a Canadian court of justice. After understanding that an "installation" had nothing to do with the officers of a secret society, his honor the judge set himself seriously to try and grasp the meaning of the many and varied technical terms in which the votaries of the science so much like to indulge. The word "voltage" caused a stay of proceedings, while it was explained to his satisfaction, and so much time was taken over it that he probably considered that was all there was to it. But the introduction of the rest of them one after another, such as "ohm," "ampere," "watt!" "potential," "drop," and so forth, was a perfect paralyzer. A witness stated that a certain contract called for a seventeen candle power light, as that was considered to be the light given by a gas burner using five feet of gas per hour. "What" exclaimed his lordship, pointing to some extra miserable burners in the court room, "a Toronto gas jet equal to *seventeen* candles! Never!!" and a fine shade of contempt crossed his expressive features as he looked at the witness over his glasses, which said as plain as words: If you can do me up with your foreign languages and outlandish names, you can't fool me with any such yarn as that. Seventeen candles! No, sir!!!

WILL electricity as a source of power ever supersede the use of steam? Years ago some enthusiastic experimenters confidently predicted it would. At present it is being used instead of steam in many places, but the very electricity which is thus used is itself produced by steam engines. It is well known that steam power can be more economically produced in large quantities, in one large central engine house, than if divided up into a number of small plants. Using electricity as a means of carrying the power and distributing it in quantities right at the machines where it is needed, it is found that the power can be more conveniently and cheaply applied. This has the appearance of taking the place of steam, and in some of the daily papers it is so put that the ordinary reader is led to imagine that the problem of the economical production of electric power has been solved. Over thirty years ago, Prof. Rankine, of Glasgow University, writing of the electro-magnetic engine, pointed out that while it showed as an engine greater efficiency than any known form of heat engine, yet the cost of producing the magnetic current was so great that a horse power produced by zinc consumed in a battery cost as much as 200 horse power produced by a steam engine. He concluded that "electro-magnetic engines would never come into general use except in cases when the power required is so small that the cost of material consumed would be of no practical importance, and the situation of the machinery to be driven such as to make it very desirable to have a prime mover without a furnace."

AT intervals during the last three years the necessity of providing means of imparting technical instruction to artisans has occupied the attention of the City Council of Toronto. On each

occasion the question, after having been to some extent considered, was on various pretexts "referred back." So frequently did it meet this fate, that its friends were almost ready to despair. It is therefore doubly gratifying to the friends of the movement to observe that definite action has at last been taken. An appropriation of $6,000 for the purpose of founding a technical school has been voted in Council, and a Board of Management appointed, comprising representatives of the City Council, the Architectural Guild, the Trades and Labor Council, the Association of Stationary Engineers and the Manufacturing interest. It has wisely been decided to establish at present but one school, to be located in the centre of the city. The course of instruction has not yet been outlined. The selection of subjects to be taught is a matter requiring the most careful consideration, and will, we trust, be approached with due deliberation and a proper knowledge of the requirements of the various classes of students. In view of the decadence of the apprenticeship system, it is from technical schools the coming generation must receive instruction of an elementary character pertaining to the various trades, a fact which should give additional interest to the present movement. Gratifying success has attended the classes for technical instruction conducted for several years past in the city of Montreal under the direction of the Council of Arts and Manufactures of the Province of Quebec, and if equal interest is manifested, the success of the Toronto school will be assured.

The Canadian Electrical Association aims to promote electrical interests in every part of the Dominion, and to include in its membership representatives of those interests in all the provinces. Therefore, wherever this paragraph meets your eye, please regard it as an invitation to become a member.

An effort is being made by the Census Department at Ottawa to obtain the necessary data for a special schedule for the electrical industries of Canada. The information required will include the name and location of each company, amount of capital stock, date of incorporation, number of employés, amount of yearly wages, number of generators, number of lights (arc and incandescent), number of motors, miles of wire, kind of motor power, capacity of station in horse power, number of dwellings, public buildings and business places for which light is supplied, capacity of station in lights, name of system used, and in the case of electric railway companies, number of miles of track operated and cars used. The circular of the Dominion Statistician requesting companies to supply the above information, expresses the opinion that "the interests of a rapidly growing industry will be promoted by the preparation of a special schedule." In what way this result is to be achieved, those representing the electrical interests are not informed. The statement is made that all information given is to be strictly confidential, and as the returns will be published as a whole, the identification of any particular firm or company is impossible. It will, of course, be a matter of interest to know the extent of electrical interests in Canada, and the rate of their development, but whether the publication of these facts will be promotive of the interests of persons engaged in electrical industries, we have not the means of judging. We presume that the Government have in view some object not apparent from their circular, which to them justifies the importance of this step. It may be the information required is to enable them to judge whether or not the present tariff on imported electrical apparatus is suited to Canadian requirements. We can only speculate on this head. In any case we trust that the information sought to be obtained will be cheerfully supplied. There can be nothing gained by withholding it. We can only hope that wise use will be made of it, and that if the result does not tend to advance the progress of the electrical industries of Canada, it will at least not prove an obstacle in the way of progress. In connection with this subject it may be stated that the reports of the electric light inspectors of the Canadian Fire Underwriters' Association show that there are now in use 3,500 miles of electrical circuits; 400 dynamos; 200 motors; and that 12,000 arc lights and 33,000 incandescent lights are burning nightly in Ontario. There are in operation in Toronto electric motors representing a capacity of 500 horse power.

The fact was recently mentioned in this paper that the City Council of Toronto had appointed the acting City Engineer and a provincial land surveyor a delegation to visit United States cities and the street railway convention at Pittsburgh and to report on the best motive power to be adopted in the operation of the Toronto street railway by electricity. The gentlemen, as previously stated, were not qualified by previous education or experience to estimate the merits of the various systems of electric street car propulsion, and form thereon their own opinions. Notwithstanding this fact, however, we are free to say that their report recommending the adoption of the overhead trolley system as the only one which can at present be depended on to give satisfactory results, is entirely justified by the circumstances. The information contained in the report might easily have been secured with the expenditure of a dollar or two for postage. Having secured it by the most costly method, it might reasonably be supposed that the aldermen would attach the greater value to it. The report was considered and approved by the Board of Works and Executive Committee, and its acceptance recommended to the Council. There its adoption was met by a protest from a company engaged in the manufacture of storage batteries, who wanted consideration of the question deferred for a period of three months to give them the opportunity of making a practical demonstration of the superiority of their system. This is the same company which took exception a year ago to some remarks in the ELECTRICAL NEWS concerning the merits of storage batteries for street railway work. They claimed that their battery was made on a new principle and that in its construction the objections commonly urged against storage batteries had been overcome. In order that these claims might be established, we offered to provide all the facilities necessary for a sixty days test of fifty plates, but were unable to induce the company to submit their apparatus to the test. Our offer to publish the results in full without charge, proved not to be a sufficient inducement to them to accede to our request. They stated that in March or April they would equip a street car, and on the tracks of the old Toronto street railway company would publicly demonstrate the practical utility of their system. It is to be regretted that March will soon have come the second time without witnessing the fulfilment of this promise. The statement was likewise made that the company would at the Montreal electrical convention give a practical demonstration of the adaptability of their system to street railway work. This promise also failed of fulfilment. In view of these facts the request which the company have preferred to the Toronto City Council deserves no consideration unless in the light of an attempt to obtain cheap advertising at the expense of a great public improvement. By reason of the representations of the company in question, and of certain aldermen regarding the undesirability of the trolley system, and on account of a provision in the agreement between the Council and the street railway company, that the company after having adopted a system, should not be required to change the same for a period of thirty years, the Council saw fit to refer back the report of the "experts" for further consideration. The provision referred to in the agreement may not be a wise one from the city's standpoint, but the agreement having been ratified, it is now rather late in the day to seek to have it altered. Certain it is that the company would not have been willing at any stage of the negotiations to agree to change its system whenever required by the city to do so, without asking from the city in return much more liberal terms than those under which it has agreed to operate the road. If the city decides that it will not adopt the trolley system, it may have to wait a considerable time for something better, and if it wants the right to compel the company to change its system when it may be thought desirable that it should do so, the re-opening of the whole question with attendant delay and perhaps litigation, is likely to be the price which must be paid.

NEW YEAR GREETING.

Mr. R. A. Lyons, London, Ont., writes to the NEWS as follows: "Enclosed find $1. The NEWS is very interesting and instructive. I wish it success, and trust it will receive the support it so justly deserves."

Frank T. and Wm. K. L. Tinning, of Toronto, have been granted a patent on a telephone receiver.

CANADIAN ELECTRICAL ASSOCIATION.

ARE you a member of the above Association? If not, why not? Have you received a copy of the constitution and by-laws and form of application? If not, write to the Secretary, mentioning the fact, and he will be pleased to forward the same to you. Address, C. H. Mortimer, Secretary Canadian Electrical Association, office of the ELECTRICAL NEWS, 14 King street west, Toronto.

The Association has a career of usefulness before it, and should receive the hearty support of every person interested in the progress and welfare of the electrical industries of the country.

The membership is divided into two classes so as to enable students and those interested but not actively engaged in electrical work to receive the benefit of attending meetings of the Association and of receiving copies of the proceedings of such meetings on payment of the modest fee of $2 per year.

Those who are actively engaged in electrical enterprises would find it to be to their advantage to become active members. By doing so, they would be brought into contact with others in the same pursuit, and by comparing notes, would derive much valuable instruction.

The electrical industry has attained to its present importance within a very brief period. There has been a great deal to learn, little time in which to learn it, and few to whom to go for instruction.

There is much valuable information relating to the successful management of electric apparatus with which the owners and operators of such apparatus in Canada require to become acquainted.

In the Association are men who have witnessed the development of the industry from its earliest infancy in this country, who have been face to face with most of the difficulties, and whose experience, as has already been said, would be most helpful and valuable to every incoming member.

With the growth of the industry comes the need for organization on the part of those engaged in it for the purpose of protecting its interests against legislation of an unfavorable character. In this direction the Association is likely to prove, as the National Association of the United States has proved, of great advantage to its members.

We are pleased with the interest which has thus far been shown in the movement, but would like to awaken the enthusiasm of many others.

The travelling representative of a Toronto supply company called on the Secretary a few days ago and got copies of the constitution and by-laws that he might make an effort to secure members for the Association. Representatives of other companies are requested to follow this worthy example, not forgetting at the same time to have their own names enrolled.

The Executive Committee will meet shortly, when steps will be taken to extend in every possible way the interests and influence of the Association, and make provision for a pleasant and profitable time in connection with the first annual meeting to be held in June in the city of Hamilton.

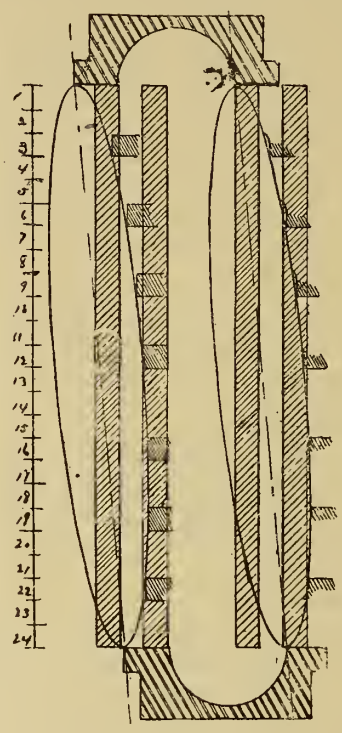
Forward immediately your application for membership, and take a hand in advancing the interests of the Association in conjunction with your own.

Do you find that owing to competition the capital and brains you have invested in the electrical business are not as profitable as they ought to be? Then you should become a member of the Canadian Electrical Association, when, in conjunction with your fellow-members, you would be in a position to work unitedly for the improvement of present conditions.

A CONVENIENT DIAGRAM FOR ENGINEERS.

By H. F. COOK.

I HAVE been asked many times by engineers some plain, simple way of determining the position of the valve, the different points of stroke, etc., and for those who are not familiar with the Zuener diagram, which I consider one of the best, I will give below a simple way of telling the position of the valve at any point of the stroke. Any engineer with ordinary intelligence should be able to understand this with very little explanation. First, lay out the valve seat on any scale; that is, a section of the seat. Place the valve in the position you wish it at the beginning of the stroke, or in other words, with the desired amount of lead. Now, lay off the length of the stroke of the engine on the same scale by drawing the steam and exhaust lines down from valve seat, a distance equal to the length of the stroke of the engine. Then at the end of the stroke draw the valve seat, and draw the valve on this seat in the position it should be in when the piston is at the other end of the stroke; or, as stated before, place the valve with the desired amount of lead from this end of the stroke, it now having its opening or lead on the opposite port, as shown in the illustration. Now, draw an ellipse on a piece of cardboard, making the length of it equal to the stroke of the engine, and its breadth equal to the travel of the valve. Draw the line through it lengthwise and cut the ellipse out of the card, being careful to make it as accurate as possible. Now, place one end of the ellipse with its centre line at the edge of the valve as shown in the cut, and the other end at the position of the edge of the valve at the other end of the stroke. Draw the ellipse in this position and this will be the line the valve travels in the forward and backward stroke.



You can space off the stroke of the engine in inches, and from any number of inches on the end of the stroke, you can find the position of the edge of valve on ellipse line.

If you draw the same ellipse from edge to edge on the exhaust port you can get the opening of exhaust the same way.

I think that upon referring to the illustration it will be plain enough, and this explanation sufficient for any engineer after knowing the stroke of his engine, the travel of his valve and dimensions of seat, to lay out a diagram of his valve in this way. Of course, the angularity, of the connection rod will make some difference, but this is not taking that in consideration, and will do for nearly all practical purposes.—*Scientific Machinist.*

The Toronto Incandescent Electric Light Company (limited) announce that a cash discount of 20 per cent. will be allowed on all accounts rendered for incandescent electric light after January 1.

It is proposed to adopt the trolley system for a new line of electric railway to be constructed from the Bonaventure depot to St. Cunegonde and St. Henri, in the city of Montreal. Eight motor cars and about twelve trailers will be required.

A movement is on foot with the object of bringing about the amalgamation of the New Brunswick Electric Light Company, of St. John, N. B., with the Gas Company or the Eastern Company. The business to be done will not warrant the existence of three companies. A gentleman who was in St. John recently expresses the belief that the Gas Company will secure control of the New Brunswick Co.

Mr. Thos. Littlehales, of Hamilton, has been granted a patent for a process of making a heating and illuminating gas by the chief agency of pure or practically pure oxygen, in a simplified form, wherein the stream of oxygen itself generates the heat for continuous gas making, and forms a portion of the body or bulk of the gas itself, and at the same time generates sufficient continuous heat to decompose steam, the products of which also enters into and forms a portion of the body or bulk of the gas, or in other words, using a gas to make a gas.

SAFETY VALVES—THEIR HISTORY, ANTECEDENTS, INVENTION AND CALCULATION.

By William Barnet le Van.

(Continued from December number.)

The experiments were made by David Rowan, with steam pressures from 5 to 45 pounds. The object was to ascertain the increase of pressure in a boiler, when all the steam raised was allowed to pass away by the safety valves, unassisted at the different pressures. The following is the table of results:

Steam Pressure at which the Valve opened.	Steam Pressure rose to, in Pounds.	Percentage of Increase of steam Pressure	Lift of Valve in Inches.	Weight of Steam in pounds Discharged
5	13	160	0.325	3.39
10	19	90	0.255	3.223
15	25	66	0.18	2.68
20	30	50	0.16	2.676
25	36	44	0.1425	2.7
30	40	33	0.1262	2.58
35	44	25.7	0.1125	2.466
40	48½	21	0.103	2.437
45	52	15.5	0.097	2.41

With flat-faced valves, according to the English Board of Trade rule, half of one square inch of area per foot of fire grate:

$$\text{The weight of steam } w = \frac{3\,P\,h}{2\,D}$$

But the valve sits being bevel to an angle of 45°

$$W = \frac{3\,P\,h}{2.\,8\,D}$$ Weight of steam discharged per minute per square foot of fire grate.

The guides, or wings, of the valve would reduce the clear opening by full one-ninth, for which no allowance has been made in the above.

James Brownlee, one of the committee of the Institution of Engineers and Ship Builders, in Scotland, in his experiments on safety-valve openings, found that with a square-edged entrance, the flow of steam was reduced from 12 to 14 per cent. The safety valve, as generally made, cannot be considered as presenting a much better entrance to the steam than a square edged orifice. In making this 14 per cent. allowance, the weight in pounds of steam discharged per minute per square inch of opening, with square-edged entrance, corresponds with very nearly three-fourths of the absolute pressure in the boiler, as long as that pressure is not less than 25.37 pounds. Examples of this are shown in the following table:

Absolute Pressure in Pounds per square inch.	Weight discharged per sq. inch of orifice. with rounded entrance, per minute.	Weight discharged per minute with square-edged orifice.	Three-fourths of absolute Pressure.
P+15	w_1	w_2	¾ p+15
25.37	22.81	19.6	19
30	28.84	23	22.5
40	35.48	30.5	30
45	39.78	34.2	33.8
50	44.06	37.9	37.5
60	52.59	45.2	45
70	61.07	52.5	52.5
75	65.30	56.1	56.2
90	77.94	67	67.5
100	86.34	74.3	75

The area of opening requisite to the discharge of any given constant weight of steam, it will be observed, is very nearly in the inverse ratio of the pressure. Thus, while 3 square inches of opening, with square-edged entrance, will discharge 3×23=69 pounds weight of 30 pounds pressure per minute, 1 square inch of opening will discharge 67 pounds per minute of 90 pounds pressure of steam.

The quantity of heat, however, requisite to generate (from water at 100°) 67 pounds weight of steam, at 90 pounds pressure, is only 1 per cent. less than is required to evaporate 69 pounds at 30 pounds pressure. The boiler which will generate 69 pounds of steam per minute at 30 pounds, cannot, therefore, possibly generate more than 67.7 pounds at a pressure of 90 pounds; but many experiments on record seem to indicate that the deficiency at the higher pressure is more than *ten per cent.*

In ordinary marine practice there is not often more than 20 pounds of coal consumed per hour per square foot of fire grate. Under these conditions, the area of the opening requisite to discharge all the steam a boiler can generate, corresponds to four times the square feet of fire grate, divided by the absolute pressure (p+15).

$$\text{or } A = \frac{4\,G}{p+15}$$

Rule.—1st. Multiply the square feet of the fire grate by the number 4.
2d. To the steam pressure add the number 15.
3d. Divide the first by the second, and the quotient will be the area in square inches.

The English Board of Trade allowance is half of one square inch area of safety valve for each square foot of fire grate. Hence, the lift of valve is proportional to the diameter, and, inversely as the pressure. For a discharge of 3 pounds per minute per square foot of fire grate, the requisite lift in inches is twice the diameter of a (flat-faced) valve, divided by the absolute pressure. This, however, does not apply to pressures less than 25 pounds (10 pounds per gauge, plus 15).

Take, for example, a safety valve 5 inches in diameter=19.6 square inches in area, which corresponds to 2×19.6=39.2 square feet of fire grate, which would evaporate 39.2×3=117.6 pounds of water per minute. Then, since the area A in square inches requisite to discharge any weight w in pounds of steam per minute at the pressure p+15, is

$$A = \frac{4\,w}{3\,(p+15)}$$

We would have, by taking the pressure p=45, and the weight w=117.6, the area

$$A = \frac{4\times 117.6}{3\,(45+15)} = 2.61 \text{ square inches}$$

which corresponds to the opening of a flat-faced valve, 5 inches in diameter, when lifting.

$$\text{Lift } h = \frac{2\times 5}{60} = 0.1667$$

The circumference of a 5-inch valve being 15.7 inches, and 15.07×0.1667 =2.61 square inches of opening, as stated.

When the angle of sit of the valve is 45°, the lift required in inches is

$$\text{Lift } h = \frac{2.8\,D}{p+15}$$

When a boiler is regularly fired, and all the steam generated discharged through an ordinary safety valve, under a succession of different pressures, the lift of valve, multiplied by these absolute pressures, should be a constant quantity, provided the same quantity of heat is constantly entering the boiler, and provided, also, that the absolute pressure in the boiler, or the pipe below the valve, is not less than 1.726 times the absolute pressure of the steam in the chamber above the valve. In actual experiment a deficiency is generally manifested at the higher pressures. Hence, the suspicion of some considerable loss of heat at the higher temperatures. It has been suggested that this might be accounted for by the low pressure steam carrying water along with it—retarding its motion—and thereby requiring a larger opening; but this would only aggravate the case, since the same opening would permit of a much larger quantity of *heat* being discharged from the boiler with wet than with dry steam. This phenomenon may be suggested as one worthy of further investigation.

According to the Prussian law, and allowing 36 square feet of heating surface per square foot of fire grate, the area A of safety valve is

$$A = \frac{36\,G}{p+15}$$

A valve of this size, when full open, is capable of carrying away nine times the quantity of steam generated at the pressure p+15, and therefore will, at the designated pressure p+15, be able to discharge all the steam by lifting 1-36 part of its diameter.

At absolute pressure of (57+15) 72 pounds, the British and Prussian laws prescribe precisely the same area of valve. Take, for example, 20.36 square feet of fire grate, which requires, by British rule, a valve 10.18 square inches in area, equal to 3.6 inches diameter, and which, if flat-faced, would, at a pressure of 72 pounds, require to lift

$$h = \frac{2\times 3.6}{72} = 1\text{-}10 \text{ of an inch}$$

Then, by the Prussian rule, the area of valve is, for 20.36 square feet of grate and 72 pounds absolute pressure,

$$A = \frac{36\times 20.36}{72} = 10.18 \text{ square inches,}$$

equal to 3.6 inches diameter; and the requisite lift is (diameter 3.6) as before:

$$h = \frac{3.6}{36} = 1\text{-}16 \text{ of an inch.}$$

The circumference of this valve being 11.31 inches, would (if flat-faced), by lifting h=1-10 of an inch, give a clear opening of 1.131 square inches, which would, at 72 pounds absolute pressure, discharge ¾×72×1.131= 61.07 pounds of steam per minute, and which corresponds to 3 pounds per square foot of fire grate—as 20.36×3=61.08.

At absolute pressures of 36 pounds, the Prussian law prescribes double, and at 144 pounds only half the area of the British.

At all pressures above 1.726 atmospheres, the area of valve, when full open, by Prussian rule, is nine times that requisite to discharge all the steam generated, while by the British rule it is four and a half times at 36 pounds pressure, and eighteen times more than is required at 144 pounds absolute pressure; and this is after allowing for an evaporation of 3 pounds of water per minute per square foot of fire grate, which is considerably more than is usually realized in marine practice.

Before the ordinary valves rise and give sufficient opening, the pressure of steam frequently greatly exceeds the load under which the valve begins to rise. Hence the requirement of large areas. With a properly constructed valve, however, such as many now in use, which rise one fourth of their diameter by an increment of 1 to 3 pounds above the load, there is no necessity for the area being much (if any) more than one-ninth of that prescribed by the Prussian rule.

$$\text{Say, area } A = \frac{4\,G}{p+15} \text{ plus the area of wings of valves.}$$

The valves here referred to are so very small that the stems, or wings,

occupy a considerable proportion of the area, and must, in the above equation, be allowed for. These small valves give much more prompt relief to the boiler, and never permit the pressure to rise much beyond the load.

PRIZE FOR SAFETY VALVE COMPETITION.

The editor of the *Nautical Magazine*, London, England, in March, 1872, offered a reward of £100 ($500) for the best 3-inch spring safety valve suitable for high-pressure marine boilers. There were five safety valves entered for trial. The boiler upon which they were all tested, under the conditions of the trial, was 33 feet long, 7 feet 2 inches in diameter, of the Lancashire

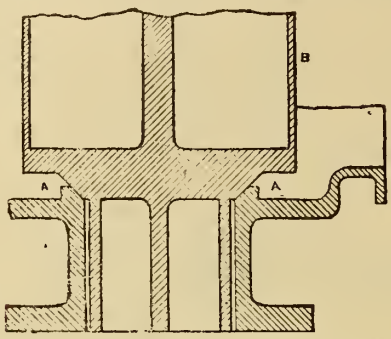


FIG. 19.—THE ROCHFORD SAFETY VALVE.

type, having two internal flues about 32 inches diameter each, inside, in which the fire grate was placed, as in marine boilers; the total area of grate surface was about 30 square feet.

The Rochford safety valve (Fig. 19) was awarded the prize. It will be seen that it has a projecting lip A, and the spring is enclosed in a case B, which can be filled with oil, if desired, for the preservation of the spring.

The editor, commenting on the trials, says, notwithstanding its absence of novelty, it would appear that an ordinary simple valve, well made, with true and narrow seating, and *long feathered wings*, moving freely in a long, truly-bored guide, meets the practical requirements so far as the valve and its seating are concerned.

For the loading of a spring valve, it would appear that a light, direct spring, with great range of elasticity, no friction, and a minimum amount of inertia, are the best means. These essential and sufficient conditions imply no novelty, and no delusive ingenuity.

In the trials, the valves were set to blow at 60 pounds per square inch, and the result was in favor of the Rochford safety valve. The umpires say, in their general remarks: "We could not raise steam above 63½ pounds

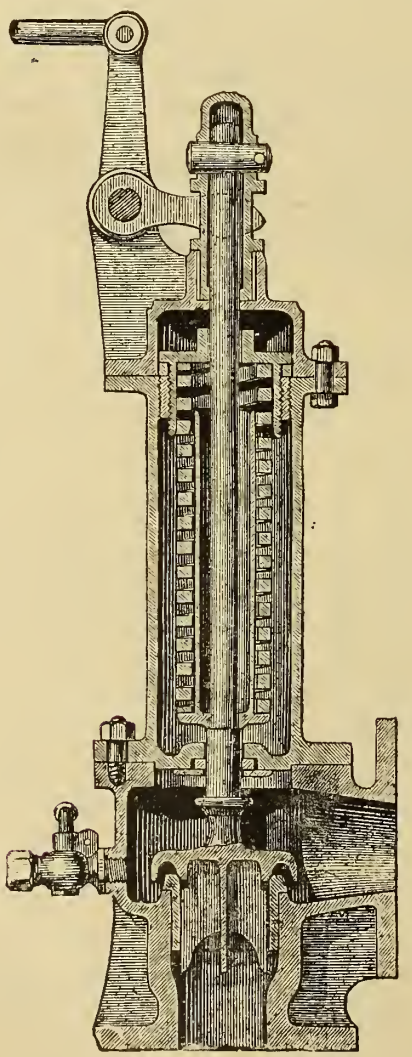


FIG. 20.—THE VENA CONTRACTA SAFETY VALVE.

pressure by this valve. Reduced boiler pressure; stopped blowing off at 60 pounds exactly."

One of the umpires remarked that he thought the Board of Trade were right enough in not adopting any of the spring safety valves yet put forward; but he could not agree in any condemnation of the spring principle, though he did not himself, as at present minded, like it as well as the dead weight; and he added, that if a more reasonable area of valve were asked than half an inch to the square foot, it would be hard (while lock-up valves are asked) to beat the old dead-weight system. The steam that is wasted in rolling, is, he said, nothing to that wasted in the continual leakage, rolling or quiet, from the huge valves which he appears to think are required by the Board of Trade.

It would appear, from the remarks of this umpire, that efficient, small, dead-weight safety valves are required, rather than ordinary valves spring-loaded.

The results of these trials seem to confirm the convictions of the arbitrators that a safety valve can hardly be too simple and direct in its action and arrangement.

During the year 1874, the Glasgow engineers appointed a committee to investigate the subject of safety valves. In January, 1875, they came to an agreement on certain recommendations. A difference of opinion on a certain "pop" valve had delayed an earlier acquiescence.

The editor of the *Nautical Magazine*, seeing that his efforts in 1872-74 were attended with very successful results in calling into existence and competition many useful safety valves, and seeing that by the exertions of the Board of Trade officers very much useful information and accurate knowledge has since been disseminated and fully confirmed by the experiments afterwards made by the Glasgow engineers, and elsewhere, it has occurred to the present editor that he may be successful in calling forth further latent talent, and stimulating invention, by offering a further prize.

Eight safety valves entered for the editor's prize of £100 ($500), and Fig. 20 shows the safety valve, Vena Contracta, for which the prize has been awarded. Owing to the sad death of the secretary of the Committee of Umpires, the details of the test cannot be given, but the following details concerning the performance of the successful valves are stated:

Conditions of the Test.

Diagram of valve in inches	3
Diagram of waste pipe in inches	3
Area of fire grate in square feet	14
Rate of combustion per square foot of grate per hour in pounds	20
Rate of evaporation per pound of coal	8.75
Temperature of feed water (constant) in degrees	100
Temperature of waste gases in smoke box	670
Steam pressure at which the valve was loaded, in pounds	4
Steam pressure in waste pipe 4 feet above the valve, in pounds	3
Duration of test, in hours	1

The whole of the steam generated had to pass through the valve, and the following is the result: One gauge, showing 60 pounds per square inch, the valve went off. The gauge instantly started to go gradually back to 59.4 pounds, when the valve closed tight, the time occupied being 13 seconds, and the mean difference between the greatest and least steam pressure being 0.6 of a pound (there being no accumulation whatever). The valve repeated this cycle of operation, during the hour's test, with unvarying regularity of pressure and time. The time was taken simultaneously by all the arbitrators from a 15-inch diameter dial clock, fixed on the wall, having a second hand moving around its periphery, and they were unanimous in awarding the prize to Vena Contracta, which has since been claimed as the valve of Thomas Adams, of Manchester.

A trial of safety valves was also made in 1874, before the chief surveyor of the Board of Trade and the chief of the Marine Department, of England, to test the proper area to relieve boiler pressure. The first trial was on a marine tubular boiler of the following dimensions: Diameter, 9 feet 9 inches; length, 19 feet 3 inches, with four furnaces 7 feet 3 inches long by 2 feet 10½ inches in diameter, with a total grate surface of 75 square feet, and 2,300 square feet of heating surface.

This boiler was fitted with two ordinary safety valves, 5 inches in diameter, having a total area of about 39 square inches, and loaded to 60 pounds per square inch pressure by direct weight—in the aggregate 2,340 pounds.

An improved valve was placed on this boiler, having a diameter of 2¼ inches, with an area under four inches, and loaded by direct weight to 50 pounds per square inch. The total weight on this valve was under 200 pounds, and the valve relieved the boiler of all the steam that could be generated, as the following will show: At the commencement of the trial the height of the water was 5 inches in the gauge glass, the pressure of steam was 48 pounds, the fires very strong, and forced in a similar manner to steaming at full speed. When the steam had risen to 50 pounds, the valve began to rise and steam to escape; three minutes after the pressure was 51 pounds, and the valve was full open—namely 9-16 of an inch. After another period of two minutes, the height of the water in the glass was 3½ inches, and the pressure of steam 52½ pounds; after another period of five minutes, the height of the water was 2 inches in the glass, and the pressure of the steam 56 pounds per square inch; after another period of five minutes, the height of the water was one inch in the glass, and the pressure of steam still at 56 pounds; after another period of one minute, the engines having been moved, the pressure was reduced to 51 pounds, and the valve began to close, and as the ship was obliged to move, the steam was let into the engines, when at 49½ pounds the valve closed. The fires were forced during the whole period of the trial with the boiler feeds, and all connections shut off; the water was steady in the glass gauge, and no water escaping by the waste steam pipe.

The next experiment was on the same boilers with the ordinary valves, being two of five inches diameter each, equaling a total area of 39.26 square

inches, loaded by dead weights of 2,355 pounds to a pressure of 60 pounds per square inch. The steam rose until these valves began to blow at 60 pounds; the fires were then forced, to get as much steam as possible, and at the end of 11 minutes (at which time the engines commenced to move again) the steam had risen to 68 pounds.

From the above two experiments, it would appear that a 2¼-inch valve is hardly large enough to discharge all the steam that this large boiler was capable of generating, at a pressure of 50 pounds; but at 60 pounds it possibly would, for, during the last five minutes, the fires were, if anything, better than at first, and the steam remained at 50 pounds *for five minutes.* The small range of pressure between that at which the valve lifted *full open*, and that at which it closed altogether, is worthy of remark.

A further trial of the same 2¼-inch valve was made on another marine tubular boiler. 12 feet 6 inches in diameter, 10 feet 3 inches in length, with three furnaces 6½ feet long by 34 inches in diameter, having a total grate surface of 46¾ square feet. This boiler was fitted with two ordinary safety valves of 3⅞ inches in diameter each, having a total area of about 23½ square inches, and loaded to 70 pounds pressure by levers and weights.

The improved valve was loaded, by direct weights, to 60 pounds per square inch, and relieved the boiler, as the following table will show:

	P. M.	Pressure in pounds.
Trial commenced	2.35	
Valve began to lift	2.37	58½
	2.38	59
Valve blowing freely	2.40	60
Full open	2.45	61
	2.50	62
	2.55	62
	2.30	63

The fires were in proper order during the trial, clear steam and no water escaping from the waste steam pipe; but the height of the water was not taken on this trial, as it was not steady in the glass, doubtless caused by the boiler having been filled with dirty water from the dock. The lift of the valve during this trial was regulated to 7-16 of an inch, previously to the commencement of the trial. It will be observed that, on the previous trial, the lift was regulated to 9-16 of an inch.

A third trial, on the same boiler, at a reduced pressure of 50 pounds, was made to test its rising and falling properties, when it was found that the valve had risen to the regulated lift of 7-16, at a pressure of 52¼ pounds, and when the pressure was reduced to 47¾ pounds the valve had closed.

These trials were witnessed by Mr. Traill, chief surveyor to the Board of Trade, and Mr. Bisset, assistant principal surveyor for Liverpool.

The editor of the *Nautical Magazine* says that the trials of safety valves for the prize of $500, show conclusively that a long spring, which is nobody's patent, is the best sort of spring if a spring is to be used at all; and the trials of the improved safety valve, as before stated, go far towards proving that a single 2¼-inch safety valve is almost sufficient, when properly constructed, to relieve a hundred horse power boiler of four furnaces, with hard firing. The valve may be loaded with anybody's spring, or with dead weights, as the fancy of the ship-owner may elect. We cannot, of course, expect the Board of Trade to allow at once a solitary 2¼-inch valve to take the place of two 5-inch valves on a large marine boiler, as such a proceeding would be in direct violation of established engineering practice; but we venture to suggest to ship-owners that they might reasonably ask the Board to allow, by way of experiment, *two* 2¼-inch improved valves on boilers of 100 horse power and upwards, in order that the experiments we have been at the pains to witness and record may be repeated and verified.

From the examination of the improved valve (Samson and Parker's), and the results of the trials, it would appear that this valve has done its work sufficiently well to warrant us in expressing a belief that two valves would be ample to relieve a boiler of 100 horse power. We should remark, that this valve has no rubbing or bearing surfaces beyond what is necessary for a common valve, and appears to be as simple, and as easily kept in repair, as a valve of the common kind of the same diameter, and certainly much easier than the 6 or 8-inch common safety valves now in use on some high pressure boilers.

If this improved valve can—as we say it can—do the whole work with such a remarkably-diminished area, then it is doubtful whether dead weights will not be better than springs.

SAFETY-VALVE LIFTS.

The height of the lift of a safety-valve governs the diameter of the valve. To find the lift, we must know the weight of steam (water) in pounds which will escape through an orifice in the boiler having an area of one square inch. This in ordinary practice, is very nearly fifty times the pressure of the steam measured from the absolute zero pressure. The area of opening, therefore, for any boiler must be, in square inches, the weight of water evaporated per hour as a maximum, divided by fifty times the absolute pressure.

The absolute steam pressure above vacuum is the steam pressure as shown by a steam gauge, plus (+) the pressure of the atmosphere, which is on an average 15 pounds (14.7 pounds exact) per square inch. The formula will be as follows:

$$A = \frac{\text{lbs.}}{50\,(p+15)}$$

Where A = the effective area of outlet.

p = steam pressure as shown on steam gauge.

lbs. = pounds of water (maximum) evaporated per hour.

15 = pounds average atmospheric pressure.

Rule.—1st. To the steam gauge pressure add 15; multiply this sum by 50.

2d. Divide the number of pounds of water evaporated per hour by the product of the first, and the quotient will be the effective area (A) in square inches.

Example.—A boiler evaporating 600 pounds of water per hour, what area of opening should the safety valve have, so that the steam pressure shall not exceed 80 pounds per square inch on the steam gauge?

$$\text{By formula } A = \frac{\text{lbs.}}{50\,(p+15)}$$

$$A = \frac{600}{50\,(80+15)} = 0.126 \text{ square inches.}$$

or, Pressure per steam gauge $80+15\times 50 = 4,750$.

$$\frac{600}{4,750} = 0.126 \text{ square inches area.}$$

United States Rule.

Board of Supervising Inspectors of Steam Vessels.

$A = D + l \div 2 \times 3.1416 \times l - 0.29$.

l = lift of valve, in hundredths of an inch.

D = diameter of valve in inches.

Rule.—1st. To the diameter of the valve add one-half the lift.

2d. Multiply this number by 3.1416, and the last product by 0.71 of the lift, for the effective area.

The conditions incident to this rule are: Diameter and lift are given; angle of inclination of valve sit must be 45° to the centre line of its axis; valve must not rise out of its sit, or above a line perpendicular to its angle of inclination, and meeting the upper edge of the sit and the lower edge of the valve. When a valve rises above a line perpendicular to its angle of inclination, the amount of area so obtained is found by the following rule:

Rule 2.—Multiply the diameter of the valve by the additional lift, and by 3.1416. Add this last product to the first, for the whole effective area.

In case the sit of the valve is flat, at an angle of inclination of 90° to the center line of axis, the effective area is found by Rule 2, leaving out the word "additional" and the last clause of the rule.

Rule 1 based upon the formula applied to finding the surface of a frustrum of a cone, the upper base of which is equal to the diameter of the valve, the lower base equal to the diameter plus (+) the lift of the valve, and the slant height equal to 0.71 of the lift.

In the trials made at the Washington navy yard, September, 1875, it was found: That the diameter of a safety valve is not an infallible test of its efficiency; that the lift which can be obtained on a safety valve, other conditions being equal, is a test of its efficiency; that the lift of a safety valve depends upon the velocity and weight of the escaping steam; that two-tenths of one inch is the maximum lift to be obtained on a common lever safety valve.

In these trials, it was found that two-tenths of an inch was all that any of the valves could be forced from their seats without a considerable increase in the pressure, equaling, in the case of a valve with an area of 5 square inches, at 10 pounds pressure, 110 per cent. excess. To get any considerable increase in the lift, it is necessary to increase the pressure in a greater ratio than that of the lift. This is but reasonable to suppose, when we consider that as soon as a valve begins to leave its sit new conditions are introduced. The high velocity with which the steam escapes reduces the pressure at and near the orifice of escape, and its dynamical effect upon the increased area of the valve is not that due the pressure when acting upon the valve at rest.

(To be Continued.)

ELECTRICAL DEFINITIONS.

In answer to a correspondent the New York *Electrical Review* gives the following definitions:

A kilowatt is 1,000 watts. A watt is the unit of electric work. A current having an electromotive force of one volt flowing through a resistance of one ohm, consumes one watt in one second; 746 watts represent an electric horse-power. A kilowatt is, therefore, about 1¼ horse-power.

A milliampere is $\frac{1}{1000}$ of an ampere, an ampere being the unit of current strength. When a current of one volt flows against a resistance of one ohm, the current will be one ampere in strength. In the formula $C = \frac{E}{R}$ (Ohm's law), C represents amperes, E represents volts and R represents ohms. The term milliampere is confined to delicate apparatus or measurements. A polarized telegraphic relay will operate with a current of from, say, three milliamperes.

A microhm is $\frac{1}{1000000}$ of an ohm, an ohm being the unit of electrical resistance. There have been several standards of measurement, but the legal ohm is the one endorsed by the International Electrical Congress of 1884. According to their standard it is the resistance of a column of mercury one square millimetre in cross-section and 106 centimetres in length at 32 degrees Fahrenheit.

A megohm = 100,000 ohms.

RUNNING AN ISOLATED LIGHTING PLANT.

By Fred H. Colvin.

It is just "starting up" time, and the engineer, at the signal, gets ready to set the plant running. He is not interested in the subject, and only does this and that because he was told, does not know why nor does he care to learn. Instead of a waterproof cover for the dynamo, as all good practice and the insurance companies direct, we see him unwrap the old piece of bagging and reveal a dynamo that would probably look fairly well if it was where we could see it, instead of being hid in this dark corner of the room.

He puts the belt on, and, as the lights begin to glow, we see that the driving pulley is directly over the dynamo; so the belt runs in its worst possible position. The dynamo has a six inch pulley, and the driver is about thirty; so we see that the arc of contact on the small pulley is sadly insufficient for the best performance of its work. It is a peculiar fact that many men who have a good general idea of mechanics on other subjects, seem to think that as soon as you begin to deal with electricity you can drop all other mechanical ideas and make belts or bearings, or, in fact anything, without regard to the mechanics of the question. In other words any thing will do, if it is for electricity. We see this idea at every step: this man would not think of running his lathes or other machinery under such unfavorable conditions; yet it is all right as "it's only the dynamo."

There are many strange features in this installation; there is not a switch in the whole building; there is not a rheostat or adjustable resistance, nor is the dynamo compounded for regulation. In fact, there is no means of regulation. The brushes have had little, if any, attention since they were new, and, of course, spark quite badly; but that is considered part of the system, and everything goes here.

Instead of examining the brushes, commutator and binding posts every day before starting up for the night's run, the engineer considers this an unnecessary performance, or knows nothing of it; not the best man to have charge of even a small plant, but a class we very often find in this position. Of course this plant does not run all night; but the principal parts mentioned should have attention just the same, the brushes, especially, if they are to be subjected to the treatment of having the bagging hauled over them every day. The machine is rarely cleaned, and save for the cover we have seen removed, it has no protection from the sweepings of the room and the occasional bath from steam when the safety valves "pop."

A pair of bellows and a paint brush will free the commutator, armature, and fields from the particles of copper and other dust that are continually floating in the air; and all shafting in the vicinity should be carefully guarded, lest it deposit oil from its bearings on the dynamo—especially upon the commutator, where it would be the cause of serious trouble. Some advise removing the brushes every day; but where this is not done they should be carefully raised and wiped with a clean cloth, to remove all dust; and the brush holder should receive attention also.

But we will leave the dynamo, and take a look over the lines, to see if we can find any poor connection or leaks, though they will be hard to find by sight, as they may be in the joints, which are, or should be, taped.

Here is something that demands attention, however. The lead wires are run up beside the wall, and there is a belt here that rubs the insulation whenever it becomes a little slack. If this was some mechanical connection of importance it would never be allowed, but it's only the electric wire, so it is all right; and it is never thought of as being of any importance. Should it make connection between the two some of these days, it may be of considerable consequence, however. We find cleats off, and the wires twisted together and hung as are easiest—by cords or wires, and now and then a nail driven into the wall to hang over. Hardly the best kind of wiring for the place, either for the safety of the building or the efficiency of the lighting plant; yet whenever a fire takes place, it is attributed to the wires, as a matter of course. This looks like a new fixture, and by a little investigation we find it is; and we also find that the change was made by a man who knows nothing about the business; so we are not surprised to learn that the joint was not soldered, but just twisted together and taped; for tape, like charity, covers a multitude of sins.

We are told by some of the workmen that they sometimes see fire run along the wires; and they also tell us that it is no unusual thing for a fuse to blow—from poor contact, probably. This state of affairs is partly due to the agents of the different companies, who tell prospective purchasers that any one can run it—no experience required, etc. Under these circumstances it is little wonder that some installations are declared a nuisance, or even worse; for in hands that are ignorant of its properties and the laws that govern its control, electricity can become a dangerous element. What mode of transmission can not?

The financial feature of the question is also of importance; the loss in the wires of a poorly constructed or poorly attended plant means money gone to waste, just as a leak in the steam pipe means wasted coal energy; in one case you can see it, and in the other you don't, though it is sometimes felt quite forcibly.

It will not take long to test the lines in a small plant, and it will discover a leak and locate it, saving power as well as removing a source of danger from fire. Any man with average intelligence can learn to test for faults in a short time; and the time spent in learning will more than repay him as well as his employer; he can then test the lines—say once a week; and can keep them in good order, to the advantage of all concerned.

We hear men say that the lamps do not give satisfaction, take more power than formerly, and much more than the agents claimed for them. And it is often the case—but as elsewhere there is a cause for all things, and the cause can often be found in the fact that the lines are not kept in good order.

A maker or dealer naturally gives the best figures he can for his wares, and sometimes I fear even goes beyond the actual figures in order to make a sale; but he is not always to be blamed when the plants are not all that is represented after they have been installed for some time. Would anyone think of expecting the best results from an expensive machine, unless reasonable care was taken of it? Yet this case is too often found, and will be until the mechanics generally know more about the laws and actions of the electric current. The time is coming when this will form part of the every-day knowledge of the progressive mechanic; and when this comes, the isolated plants will give much better satisfaction to all concerned.

It may be extravagnat to suggest a volt-meter for a plant of fifty lamps; but it would have been a profitable investment in at least one case in the writer's knowledge, where about fifty lamps were burned out in short order—due to running too high voltage. A volt-meter will act as a safety valve for the lamps, by showing the attendant when the voltage rises above the normal.

The fuses are not to protect the lamps—though this is the prevailing impression among the uninitiated—but to protect the wiring from heating to a dangerous extent when the current for any reason is abnormal.

Although safety plugs or fuses are marked in lamps, it simply expresses their capacity in 16 candle-power lamps, instead of amperes. They blow when the current becomes too great for the carrying capacity of the wires they protect.—*Power.*

TRADE NOTES.

The Windsor and Sandwich Electric Railway, a description of which appeared in the Electrical News for December, use three friction grip pulleys manufactured by the Waterous Co., Brantford. One of these pulleys was examined with much interest at the recent meeting to form a Canadian Electrical Association. One of the delegates pointed out that this pulley differs from others in being capable of being adjusted without stopping the shaft or interfering with other pulleys, the grips being always motionless when out of clutch.

To the Toronto Construction and Electrical Supply Co., Toronto, belongs the credit of being the first wholesale electrical supply house in Canada to canvass the entire Dominion by means of capable travelling representatives who each carry with them several sample trunks filled with samples of the latest and best novelties for electrical uses. At the present time one representative is in British Columbia, another in Halifax, N. S., and four others at various points between the two first mentioned, which are nearly 4,000 miles apart, and as a result of such a progressive policy, the business of the company has increased with great rapidity. All purchases made by the Toronto company are for prompt cash, and consequently they buy to the best advantage.

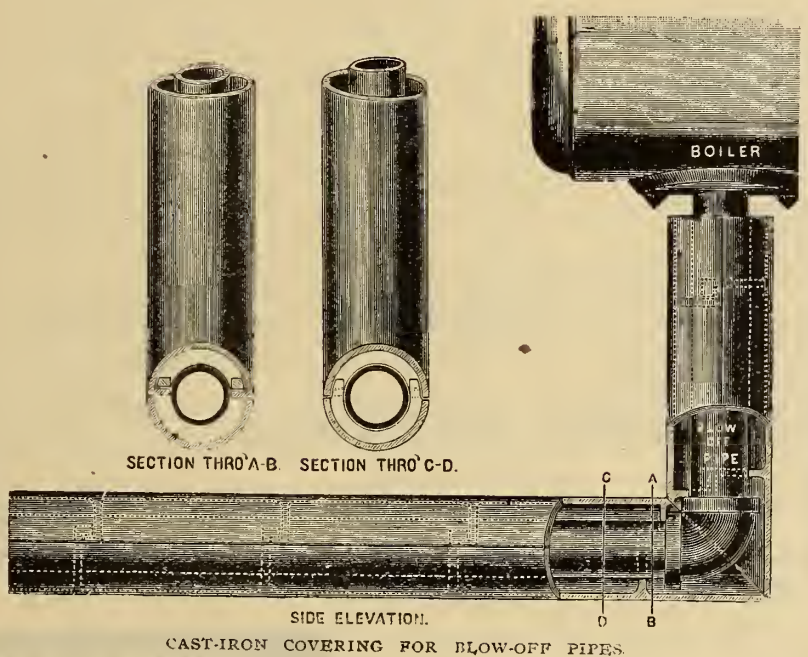
We note the issue of letters in New Brunswick incorporating the Kingsley Steam Boiler Company, limited, and the McNaughton Gold Company, limited.

BLOW-OFF PIPES.

AMONG the defects reported by our inspectors many defective blow-off pipes occur, and accidents often arise from this source. The defects are usually due to the burning of the pipes. When sediment is present in the feed water, the pipe becomes partially filled with it, and overheating is the result; and even when the water is pure, the high temperature to which the blow-off pipe is exposed seems to cause the water to attack the iron, and deterioration may be quite rapid.

Much of this trouble seems to be due to the flame striking directly against the pipe, and to overcome it, it is customary to slip a cast iron sleeve over the pipe to protect it. A piece of soil pipe is the usual thing for this purpose. This in turn becomes burned away, and to replace it, it is necessary to disconnect the blow-pipe and run it through the new sleeve. To avoid this trouble, half sleeves with lugs or flanges, fastened together with bolts, have been used, but these have not proved perfectly satisfactory, as the projecting lugs are apt to burn away after a little while.

Steam users have often asked our inspectors for something not expensive, which could be put on without disconnecting the blow-off pipe, and some years ago we made drawings for a sleeve having supporting rings with lugs so arranged that the two halves could be securely fastened together without bolts or nuts. The details of the sleeves will be seen from the cuts. Inside of the sleeve half rings are cast, the internal radius of which is slightly larger than the blow-off pipe. At the ends of these half rings hook-like lugs are cast, which serve to fasten the parts of the sleeve together. In putting this covering on, one-half of it is first laid against the pipe, and the other part is brought down upon it with one end hanging half or three-quarters of an inch over the end of the first half. The two are then slid together until the hooks or lugs inside lock together. The dimensions of the sleeve may be altered at will, but we have recommended the following for a two-inch blow-pipe: Diameter of cast iron sleeve internally, 3⅞ inches; thickness of casting, ¼ inch; distance from one supporting ring to the next, 8 inches. The ends of the horizontal and vertical lengths are, of course, beveled so as to fit together, and care must be taken that the lugs or hooks that secure the parts together do not come within, say, an eighth of an inch of the blow-off pipe or the sleeve itself, as otherwise the parts will be likely to become iron-bound under the intense heat to which they are exposed. If the brick-work is so arranged that a small amount of air can enter the sleeve, a circulation can be maintained through it that will give further protection to both sleeve and blow-off. The rings in the sleeve will prevent the air from drawing freely through, but it will be found that enough will pass by them to be of benefit.



CAST-IRON COVERING FOR BLOW-OFF PIPES.

We believe this arrangement has proved satisfactory, and any one wishing to use it can make a pattern, one pattern being sufficient if it is made long enough, since shorter pieces may be cast by simply cutting off in the sand mould to the length desired.—*The Locomotive.*

Two additional Brill cars have been ordered for the Spring Ridge, Pandora Street and Beacon Hill Park extension of the Victoria, B. C., Tramway Company's line.

The Erie Glass Co. is being organized at Port Colborne, Ont., by Mr. James Lydiatt, of Toronto. The works, in which natural gas will be used as fuel, are intended to produce gas goods for electric lighting. It is said that the importations of flint glass goods into Canada last year amounted to half a million dollars.

A REALISM.

"At last we are alone!"

It was the man who spoke.

The woman trembled and lifted her eyes to his face.

They were beautiful eyes, but they were tremulous eyes—eyes which look out from a heart which is irresolute, fearful.

He stamped with his heavy foot upon the floor of the room.

The echoes brought back in their invisible arms the sound, and let it ripple out again until it struck the walls once more and fell into the vast void of silence.

A bat, disturbed by the unusual activity, darted from a corner and blindly dashed in eccentric convolutions about the dusty building.

Great ropes of cobwebs hung down from the ceiling, and across the corner of the room dead flies swung lightly in the hammocks the spiders had fastened there.

The dust rose in listless clouds from the shock of the heavy footfall, and sank again, overcome by its own inertia.

Even the air was resting.

The spirit of the desolation seemed to pervade the place.

The woman looked furtively around upon her dim surroundings and shivered.

The man laughed harshly.

"Alone, I said," he growled.

"Yes," she murmured.

A faint light struggled in through the great windows in front, thick with dust.

"Where are we?" she whispered and shivered as the bat dashed into her hair.

"Listen," he replied hoarsely, "we are in a store which does not advertise."—Detroit *Free Press.*

EXPERIMENTS UPON THE VELOCITY OF STEAM.*

A SERIES of observations upon the peculiar shapes assumed by a jet of steam upon issuing from orifices of different forms, led the writer to the supposition that a discharging nozzle could be so proportioned as to give the maximum efficiency of expansion under given conditions, and numerous experiments were therefore made to determine the internal pressure and velocity of the steam at different sections of tubes of various shape. The results obtained at 30, 60, 90, and 120 lbs. initial gauge pressure are shown by diagrams and tables accompanying the paper, and indicate very interesting results, while the characteristics of some of the tubes are quite marked. As might be expected, a cylindrical nozzle is shown to be the least efficient, and the terminal velocity of the steam in this tube is found to be the same as at the initial section of the tubes with divergent taper. In the latter style of tube, the steam has more opportunity for expansion, and the terminal velocity approaches more closely the theoretical value.

A peculiar circumstance is noted in the text and made very apparent by the diagrams, viz: that in a well proportioned nozzle or thin diaphragm, the actual velocity of discharge at the minimum section is very nearly constant for all the pressure of steam used in the tests: and for any other section of the tube, the same condition obtains as long as the expansion is continued. This qualification seems to be necessary, as several instances are given where the expansion within the nozzle falls far below the atmospheric pressure, and subsequent contraction causes a loss of velocity.

This fact of constant velocity of discharge under certain conditions is commented upon at some length and shown to give good grounds for the use of Napier's formula for discharge of weight of steam, with the suggestion that the use of the initial density of steam instead of the absolute pressure might give even more accurate results.

* Abstract of a paper by Strickland L. Kneass, in *The Proceedings of the Engineers' Club of Philadelphia*, Vol. VIII, No. 3.

NOTES.

If you put green coal close to the furnace doors and then press it away as it cokes, you will burn out the gases and dispel a nuisance that shows itself in several forms.—*The Safety Valve.*

The mechanic who does not possess a rudimentary knowledge of electrical matters, writes James F. Hobart in the *Northwestern Mechanic*, is out of place and there is little demand for his services at the present time. As the uses of electricity increase, the engineer must add to his knowledge of matters electrical, and this can only be done by study and by practical experience among electrical machinery.

It seems only a question of time, and not a very long time either, when electricity will play a most important part in every-day work in mill and factory. It does not require any great stretching of one's imagination to see a mill operated by electricity, each machine with its own motor, stopped and started independently of any other machine, and giving trade papers little chance for long articles on the proper methods of erecting and caring for shafting, hangers, belting, etc. —*Wood-Worker.*

An exchange informs us that the method of making an electrical connection to a governor of an engine in such a way that the engine could be instantaneously stopped on the pressure of a push button which was devised some time ago, has been found to work so well and to provide such a valuable addition to the provisions against accident, which are necessary where light bodies of machinery are constantly in motion, that in many factories these push buttons have been placed in convenient positions all over the floor in which machinery is working. In case of accident from any cause whatever, any person who happens to be nearest to one of the push buttons by pressing it can instantly bring the engine to a standstill. This device has already been the means of saving life where persons have become entangled in moving machinery.

THERE IS BUT ONE PORTLAND

Oregon, and it is best reached via Chicago and St. Paul over the through Sleeping Car Line of the Chicago, Milwaukee & St. Paul and Northern Pacific Railways. For further information apply to the nearest ticket agent or address, A. J. Taylor, Canadian Pass. Agent, 4 Palmer House Block, Toronto, Ont.

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We have the following Leather Belts in use in the works of the Toronto Electric Light Co. :—

One 36 inch belt 98 feet long.
One 36 inch belt 100 feet long.
One 36 inch belt 123 feet long.
One 38 inch belt 100 feet long.
One 24 inch belt 100 feet long.
And over 1500 feet of 8 inch belting.

All of the above belts are DOUBLE THICKNESS. The 38 inch belt is the largest belt ever made in this Province.

We are prepared to furnish belts of any size, two or three ply up to 48 inches wide. Every belt fully guaranteed.

SEND FOR DISCOUNTS.

Dixon's Belting Hand-Book mailed free on application.

SPARKS.

A new electric light company is projected at Moncton, N. B.

The Miramichi Telephone Company is being incorporated at Chatham, N. B.

An incandescent plant is being installed by the Galt, Ont., Electric Light Company.

The Chatham Electric Light Company, Chatham, N. B., is being incorporated with a capital stock of $20,000, for the purpose of establishing an electric light plant in that city.

Mr. Charles Myles, of Hamilton, who is endeavoring to form a company to build an electric railway from the eastern terminus of the Hamilton and Dundas Railway to Grimsby, touching at Bartonville, Stony Creek, and Winona, has secured subscriptions to the amount of $75,000. The city of Hamilton will be asked for a bonus of $25,000. The cost of the road will be $175,000. The trolley system will be used. The intention is to locate the generating plant on the Welland Canal. Considerable revenue is expected from the carriage of fruit for the Hamilton and Toronto markets.

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SAVES 1000 POUNDS OF COAL EVERY TWENTY-FOUR HOURS.

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GAST & CO., Toronto, Ont. Windsor, Ont., Dec. 31st, 1889.

Gentlemen: In reply to your request for my opinion respecting Boiler Covering, I consider your covering good. You have done us a first-class job, and it saves us ten hundred pounds (1,000) of coal every twenty-four hours.

Yours respectfully,

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NOTES.

Paint your boiler fronts white; black radiates more heat than any other color.

How much ash does your coal give? If you don't know this, you should lose no time in getting the information.

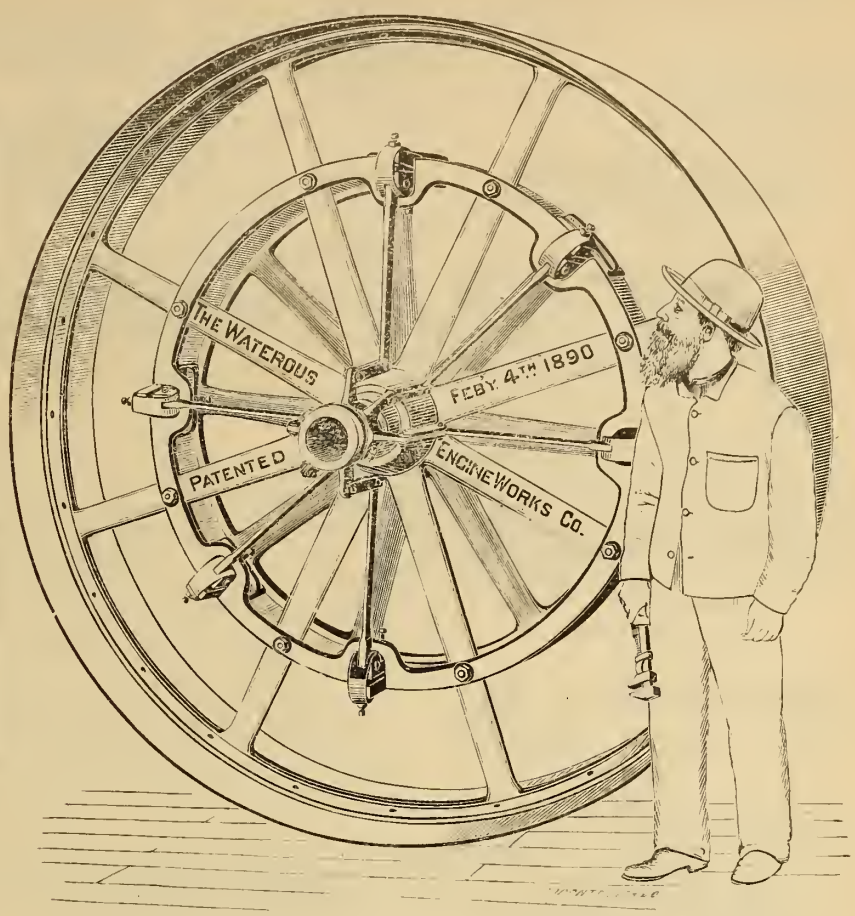
The power absorbed by the reciprocating parts of an engine during each stroke is equal to their weight lifted as many feet high as would be necessary in order to produce their velocity by falling. This can be calculated by the rules relating to the velocity of falling bodies.—*Stationary Engineer.*

Phonographs are to be used in Mexican post offices for the benefit of those who cannot read or write. The illiterate Mexican will go to the post office, talk his message into the receiver of the phonograph, and when the cylinder reaches its destination the persons addressed will be sent for and the message will be repeated to him from another machine.

Inexpensive but handsome incandescent lamps are now being made in various colors. The bulbs are made of white glass and then dipped in colored varnish, which is as durable as the lamp itself and is transparent. Sandblasting a lamp first and then dipping it in red vranish is said to produce a fine rose-colored effect, and even lettering on the bulb may be produced in this way.

The practice of expressing the economy of a steam engine in so many pounds of coal per horse power has been almost universal in the past, and though some few engine builders are using a diffcrent standard, the former may still be considered the prevailing method. Certainly nothing could be more fallacious than to speak of the consumption of fuel by the engine, which consumes steam only, or should if proper conditions exist. An improved automatic cut-off engine is sold under a guaranty of, say, three pounds of coal per horse power per hour. How does the maker arrive at this figure, not knowing the economy of the steam generator? With an average boiler performance, the quantity of steam supplied to the engine on the above rating will be that due to the evaporation of about seven pounds of water evaporated per pound, or 21 pounds of water per three pounds, from and at 212 degrees Fahr. Therefore the economy of the engine should be rated at 21 pounds of water per horse power per hour, instead of three pounds of coal.—*Iron Age.*

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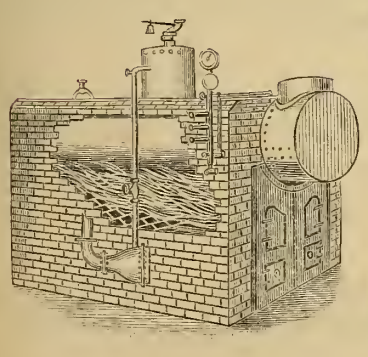
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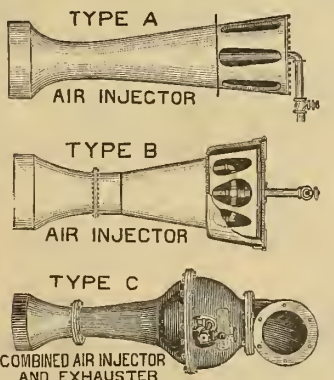
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Testimonial from the Wilson Publishing Company,

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Yours truly,

S. R. EARLE, ESQ., Belleville, Ont. (Sgd) S. FRANK WILSON.

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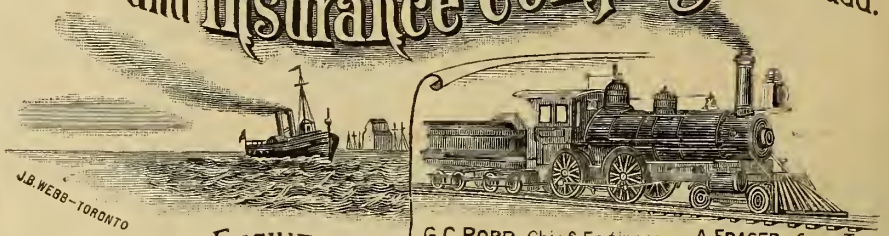
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Superintendent's Office, Water Works Dep't,
TORONTO, January 6th, 1891.

ALONZO W. SPOONER, ESQ.,
Port Hope, Ont.

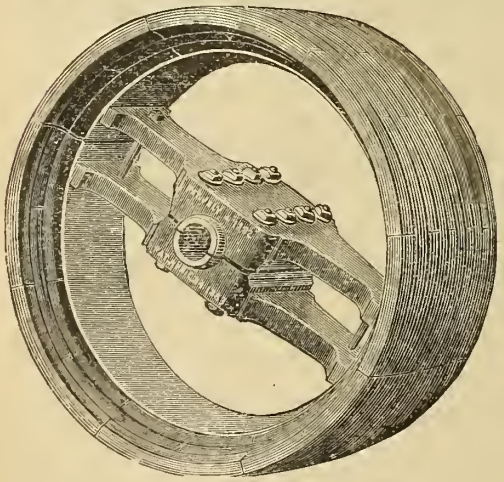
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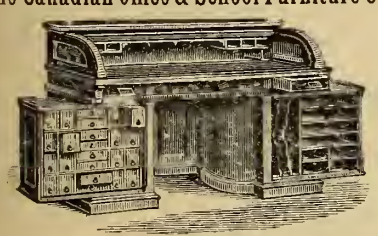
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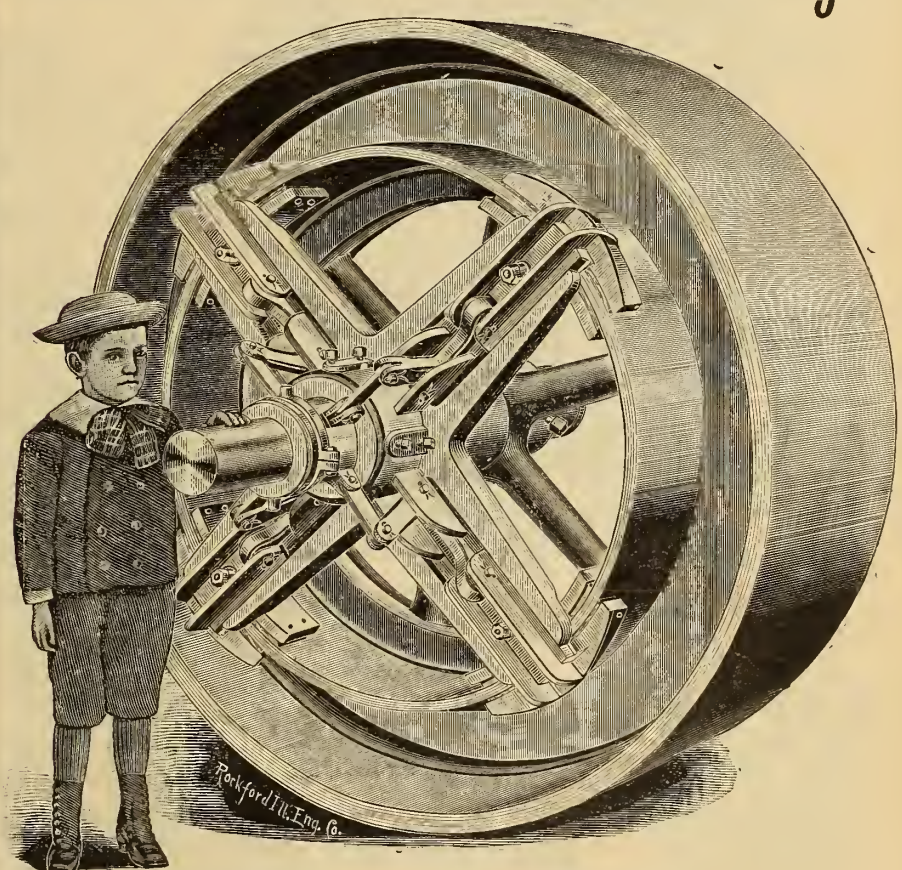


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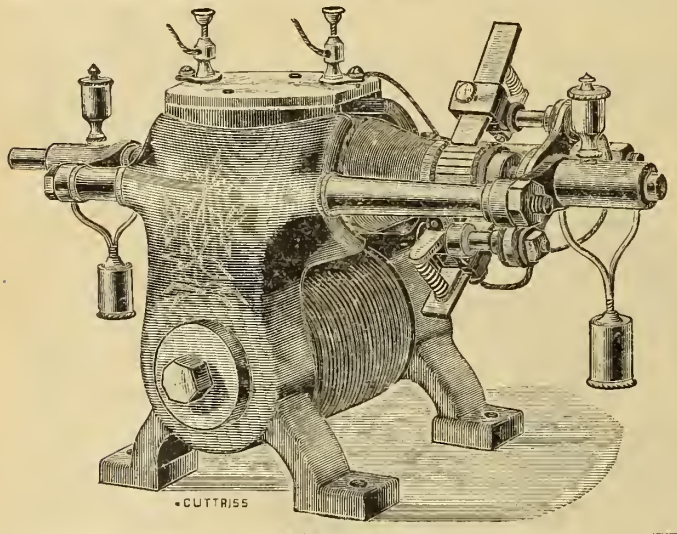
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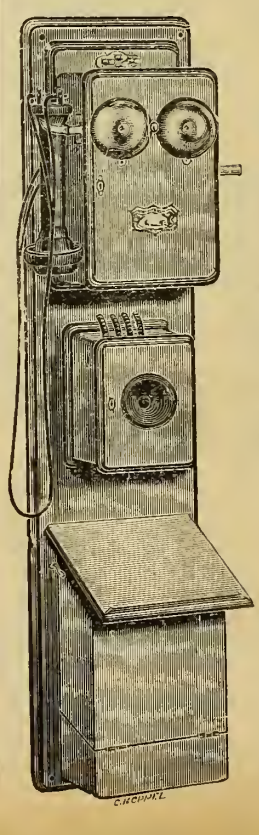
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FROM THE FAR WEST.

KAMLOOPS, January 8th, 1892.

Editor ELECTRICAL NEWS.

DEAR SIR,—I will send you the fee required to become a member of the Canadian Electrical Association in a couple of days. I send you by this mail one of my calendars, which please accept with my best wishes for your enterprise. I sold my electric light plant here to a company for $9,300, retaining $4,500 worth of shares. The institution is doing well, and expect to add a 500 light dynamo (1000 volt machine) very shortly.

Again wishing you success, I remain,

Yours truly,

J. E. SAUCIER.

"CANADA FOR THE CANADIANS."

Editor CANADIAN ELECTRICAL NEWS.

SIR,—The head line to this article should be the watch word for all persons engaged in any electrical industry in Canada, when any thought or consideration is given to joining an electrical association. It is hard to conceive how a person engaged electrically in Canada can become a member of a National Association—national in the United States only—in fact, that Association is a traitor to its very name in accepting members who are not "National" in their character, according to their standard, which we take it means "national" in the United States only—consequently there should be no hesitation as to which association Canadians should become members of and there should be no holding back by any one interested in joining hands to make the Canadian Association shine just as brightly, and do just as much good in its way, as the National Association does on the other side of the line.

There seems to be an effort in some directions to discourage any one who contemplates becoming a member of the Association in Canada, and to favor their joining the U. S. Association. Surely no one who has Canadian interests at heart, nor any one who is operating an electric plant of any kind in Canada, can doubt but that it is his bounden duty to uphold the Canadian Association first, last, and all the time. There are, we know, quite a number of the knights of the screaming eagle among us who are doing good work in operating or managing electric companies in Canada; even they must see that the only proper path for them to tread is to become active members of the Canadian Association, for is not their entire interest centered in trying to make a Canadian company pay a dividend to its shareholders and thereby have their own conditions bettered? and is not their very living expenses paid by Canadian dollars? It therefore becomes to them purely a Canadian industry, and they become Canadians as it were in consequence, under which conditions one would have to stretch his imagination to a large degree to give even a thought to going into a national U. S. Association.

It is difficult to understand by what means the U.S. National Electric Light Association so far stretched their nationalism—if we may be allowed the expression—as to hold a convention outside of the nation, as they did their last one, simply because one of their "*Canadian-national*" members suggested it. No doubt they enjoyed themselves and had a good time generally, but they evidently must have been so much elated over the proposition as to be entirely blind to the fact that their convention could not be a national one in Montreal, under the Queen's flag, any more than if it had been convened in Asia or China. Now that they have so far digressed from their nationalism, would it not be a good scheme for them to hold their next convention, after the Buffalo one, say in London, Eng., or one of the large continental cities? What a glorious opportunity to take in some of the large electric plants in operation on the other side of the pond!

In conclusion, if any of your readers are thinking of becoming members of an electrical association, and are fitted therefor by connection with electrical industries in Canada in any shape or form, their interests must centre in the Canadian Association. It will welcome them and they are bound to profit by their connection with it. I feel sure that if they look before they leap, their leap will be into the new and well organized Canadian Electrical Association, the first yearly convention of which will be held on the second Tuesday in June of the present year, in the city of Hamilton, and which bids fair to be of two or three days duration—with a running exhibition of electric apparatus of all kinds and a general display of electrical appliances.

Yours truly,

"CANADA."

A MODEL CENTRAL STATION AT NIAGARA FALLS.

NIAGARA FALLS, ONT., Jan. 14, 1891.

Editor CANADIAN ELECTRICAL NEWS.

DEAR SIR,—As my business necessitates my travelling around the country a good deal, and having for several years been engaged in the electric light business, I concluded that the readers of your valuable journal might be interested in reading descriptions of some of the different installations of lighting plants throughout the province.

Last night I was looking through the central station of the Niagara Falls Electric Light Company. It is a limited stock company composed of citizens of the town. The officers are: Mr. J. Bampfield, President; Mr. J. Quillman, Secretary; Mr. Wm. Doran, Treasurer; Capt. Carter, Superintendent.

The station is a neat little building near the Clifton depot of the M. C. Railway. The streets of the town are lighted by 60 2,000 c. p. arc lamps, which are supplied by a 65 light 9·6 amp. Wood arc light dynamo, and I must say that the satisfaction expressed (by many prominent people of the town) with the street lighting must be pleasing to the Electric Light Company, and certainly is very creditable to the Edison General Electric Co., who supplied and installed the plant.

Mr. J. Foster, who has charge of the electrical department, and through whose kindness and courtesy the writer was allowed the privilege of going over the station, speaks very highly of the Wood arc dynamo. There are also two Edison incandescent dynamos, each having a capacity of 360 16 c. p. 110 volt incandescent lamps, run on the three wire system.

There is a fine switch board connected up on bus bars, with all the necessary ammeters, voltmeters, and ground testing instruments necessary to all first-class plants.

The power is transmitted from the engine to a counter shaft, from which the two incandescent machines are driven direct. The Wood arc machine is driven from countershaft by a Goldie & McCulloch friction grip pulley. This arrangement allows the arc machine to be started up or shut down at any time without interfering with the rest of the plant, and is very handy, as the incandescent machines have to be started up much earlier than the arc, and are also run until a later hour in the morning.

The power is furnished by an eighty-five h. p. Wheelock engine, running 96 revolutions per minute, supplied with steam by a 60" x 14', 98 3" tubes, steel Goldie & McCulloch boiler, which is fed by a Northey pump and Plunger pump, the latter being driven by belt from crank shaft of engine.

The position of engineer is filled by Mr. George Perrie, and they do not yet know what a "shut down" is.

This station (for a central). to use a vulgar phrase, "takes the cake" for cleanliness and good order in each department, and is a credit to the men in charge. In conclusion, I will say that there are many stations in the country that might, with profit to themselves and better satisfaction to their customers, take pattern from the central station of the Niagara Falls Electric Light Company.

Yours truly,

"TRAMP."

ELECTRIC MOTORS.

Motors may be classified as:—

1. Series motors, in which the field coils are connected in series with the armature.

2. Shunt motors, in which the field coils are connected in shunt or parallel with the armature.

3. Compound-wound motors, which have both the shunt and the series winding.

This latter class may again be subdivided into:

A. Differential motors, in which the series coil magnetizes the field magnets in opposite polarity to the shunt coil.

B. Cumulative motors, in which the series coil magnetizes the field magnets in the same polarity as the shunt coil.—*Electrical Age.*

There has recently been discovered near Kamloops, B. C., a deposit of mica of excellent quality.

LOSSES IN AUTOMATIC STEAM ENGINES—AND THEIR REMEDIES.*

ONE of the first conditions necessary to economy may be said to be high initial pressure in the cylinders. The higher the initial, the greater the economy that can be obtained in its use. Another condition is, that steam be cut off at such a point in the stroke that the expansion curve will, at the termination of the stroke, reach nearly to the back pressure line without touching it. Theoretically the higher the initial and the lower the terminal, the greater the economy (always provided that the terminal does not go below the back pressure line); but in ordinary practice this does not hold good owing to two very serious losses that occur in single unjacketed cylinders, viz., condensation and clearance. The first of these, viz., condensation, is due to the variation in the temperature of steam during expansion. For example, if steam at 80 lbs. gauge pressure or 95 lbs. absolute, be expanded to 20 volumes in a condensing engine, the initial temperature would be 324° Fah. and the terminal about 160°—a change of 164° in temperature during each stroke.

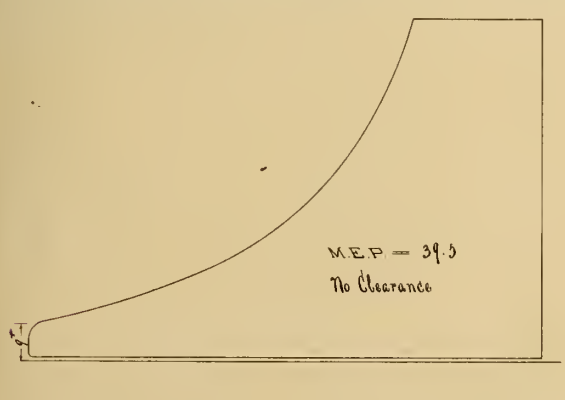
As the temperature of the steam falls during expansion, the temperature of the walls of the cylinder fall in like proportion, so that when the boiler pressure is again admitted to the cylinder, it takes a certain proportion of the steam admitted to raise the temperature of the surrounding metal to the initial steam temperature. The greater the ratio of expansion, the greater the variation in temperature between the initial and terminal, and also in the metal of the cylinder, and the greater the proportion of steam required to raise that temperature each stroke. The laws that govern the losses by condensation are, therefore, in direct opposition to those governing the theoretic gain by expansion. On the one hand the greater the ratio of expansion the greater the gain; and on the other hand, the greater the ratio of expansion, the greater the loss (by condensation). From experiments carried out, the losses "for unjacketed non-condensing cylinders have been computed approximately as follows, with steam pressure at 80 lbs. expanded to :—

VOLS.	POWER.	LOSS.
20	55	45
10	65	35
5	75	25
3	80	20
2	85	15

With 5% added for condensing engines. And the theoretic gain in condensing engines by expansion, "taking 80 lbs. gauge pressure without expansion as a basis," is as follows :—

VOLS.	GAIN.
20	70%
10	65
5	60
3	50
2	40
1½	20

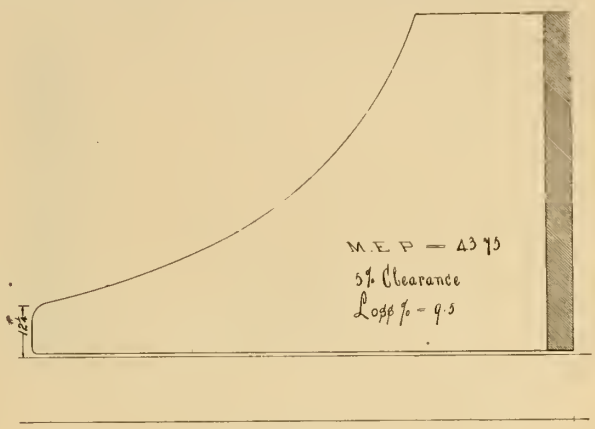
That is to say, in an engine expanding steam 20 volumes theoretically, 70% of the work would be done by expansion after



CARD NO. 1.

the admission valve is closed, and with 10 expansions 65% of the work is done by expansion after the admission valve is closed, and so on. Now as to the second loss, viz., "clearance loss." Clearance is the volume of space between the piston head and valve face "when an engine is on its centre, including ports, passages, etc., which have to be filled with steam each stroke before the piston moves forward on its stroke, and is computed by the percentage its volume bears to the piston displacement—*i. e.*, the area of the piston multiplied by the length of the stroke. This percentage varies from 3 to 5% in long stroke engines, and 15, and even 20% in short stroke, or high speed engines. The loss by clearance is quite a serious one when steam is used expansively, and also in short stroke engines when the clearance forms a large percentage of the volume of the cylinder.

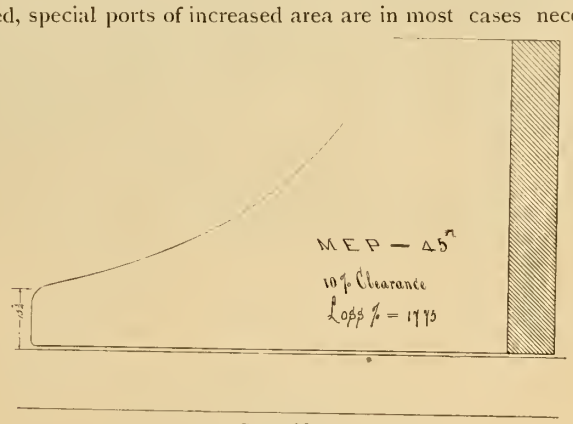
A certain amount of clearance is an absolute necessity in all engines, and cannot be reduced beyond a given point, for if the



CARD NO. 2.

port area be reduced another serious loss is incurred, viz., wire-drawing or throttling. A certain amount of clearance is required also at each end of the cylinder to allow for wear of rods, adjustment, etc.

We will take a few examples to form an idea of its volume and effect in different classes of engines. For the first, viz., its volume, we will assume a cylinder of 12″ in diam., 36″ stroke, which is about the ordinary proportion for a long stroke engine. With well proportioned steam ports, passages and clearance we will find that the clearance area will be something between 3 and 5%, say 5%. Now if we reduce the stroke of this engine to 24″ instead of 36″, but retain the same port area, etc., which cannot be reduced no matter what the stroke may be, then the clearance volume will be increased from 5 to 7½%, and if the stroke is still further reduced to, say 12″, which is not unusual in short stroke or high speed engines, the clearance volume is again increased to 15%, and this in most cases is still further increased owing to construction. A single valve only being used, special ports of increased area are in most cases necessi-



CARD NO. 3.

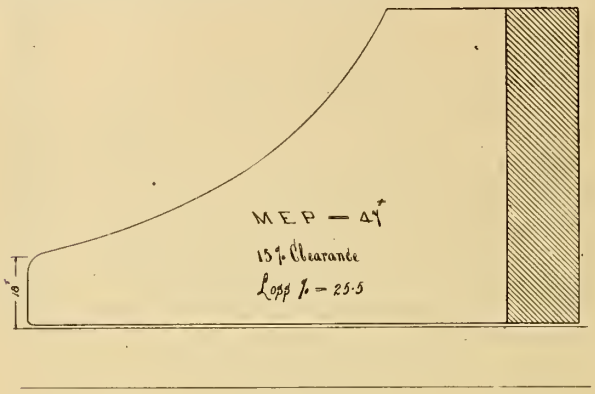
tated, so that we may safely assume 15% clearance as a fair *average* for short stroke engines, and 5% for long stroke engines.

It is owing to this high percentage of clearance that the short stroke or high speed engine has never, and never can, give as good results as the long stroke engine, from an economical standpoint. To form an idea of the effect of clearance under different circumstances, we will examine a few theoretical cards, and by computing the power, or M.E.P., draw our comparisons, and for that purpose we will just take up a few high pressure or non-condensing cards. For a standard, we will assume card No. 1 which is laid out without clearance. Cut off at ¼ stroke, with initial pressure of 80 lbs. In this case we obtain an E.M.P. of 29.5 lbs. with a steam consumption of 18.9 lbs. For card No. 2 we will assume same gauge pressure and same point of cut-off, but with 5% clearance. In this case the volume of clearance is equal to a M.E.P. of 4 lbs., and the card gives 43.75 lbs. with steam consumption of 20.5 lbs.; thus the loss caused by clearance is equal to 9½%. For card No. 3 we will assume 10

* Paper read by Mr. W. H. Laurie before the members of the Montreal Branch Canadian Association Stationary Engineers.

clearance, with all other conditions the same as before. In this case we have a M.E.P. of 45 lbs. with a steam consumption per H.P. of 23.2 lbs., and a clearance M.E.P. of 8 lbs., showing a loss in the card of 17.75% caused by clearance. For card No. 4 we will assume 15%, with all the conditions as before. In this card we get a M.E.P. of 47 lbs., a steam consumption of 25.40 lbs. per hour per H.P., and a clearance M.E.P. of 12 lbs., representing a clearance loss of 25.5%.

Now if we apply the law governing the theoretic use of steam to these cards, *i.e.*, the greater the ratio of expansion the greater

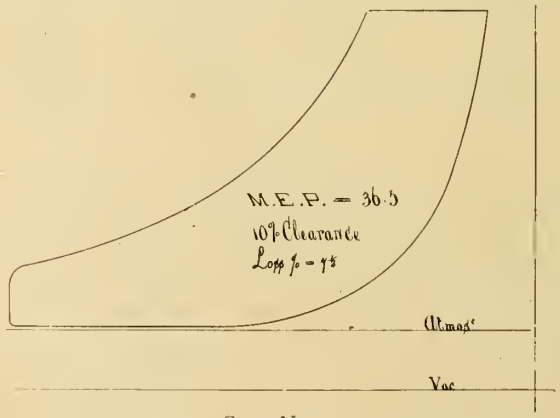


CARD NO. 4.

the economy—we will find that the increased loss by clearance will more than equal the theoretic gain by expansion in some cases. We will assume that each of the three cards are reduced in power by 50%. Then we have for card No. 2 a M.E.P. of 19.75 instead of 39.5, with a clearance loss increased from 9½ to 19%. No. 3 card, trialed in the same way, will show a clearance loss of 35.5% instead of 17.75 ; and card No. 4 would show a loss of 51.% instead of 25.5. Then on the other hand if we increase the M.E.P. or power developed, we reduce the clearance effect in exactly the same proportion.

While we are investigating the high pressure cards we will take a few examples to show the effect of compression in its relation to clearance. In single valve automatic engines compression cannot be obviated if it were so desired. There is quite a diversity of opinion among engineers as to the advantages of compression, some claiming that clearance loss may be entirely obviated by judicious compression ; others that compression is only a necessary evil.

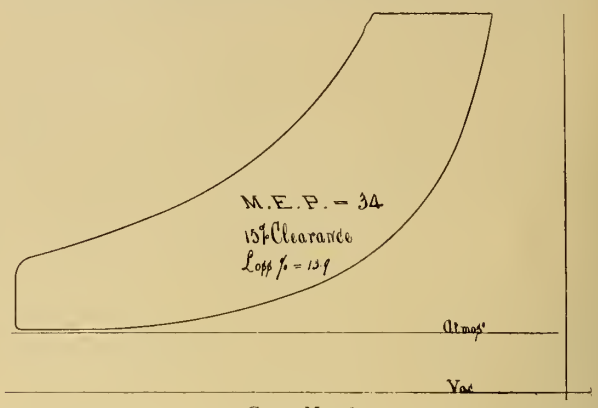
For our first example in compression we will take card No. 5 with 10% clearance. All conditions are identical with card No. 1, viz., steam pressure 80 lbs., cut-off at ¼ stroke, except that the exhaust has been closed at such a point in the stroke that the theoretic compression curve reaches to the initial pressure. The same quantity of steam has been admitted to the cylinder as in card No. 1, but the M.E.P. obtained is only 36.5 instead of 39.5 ; this is equal to a clearance loss of 7½%. For our second compression card we will take card No. 6, which is laid out with



CARD NO. 5.

15% clearance, and compression to initial pressure—all other conditions as before. In this case, although the same quantity of steam was admitted to the cylinder as in card No. 1, the M. E.P. has dropped from 39.5 to 34 lbs., or a loss of nearly 14% due to clearance.

For our third compression example we will assume a card with 20°/₀ clearance, and compression up to the initial pressure. In this case with same quantity of steam admitted to the cylinder, as in No. 1, the M.E.P. is reduced from 39.5 to 31 lbs., or a clearance loss of 21.5%. The loss through clearance in theoretic compression cards is caused by the large area that is deducted from the card by compression, necessitating the steam being cut off at a later point in the stroke than it would otherwise occur to

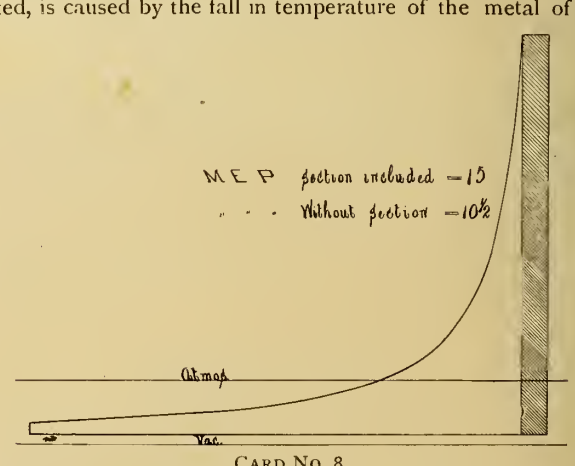


CARD NO. 6.

develop the same power, and thus reducing the ratio of expansion and consequent economy to the percentage mentioned in cards 5 and 6.

In comparing cards with compression and those without compression, although the compression cards show much less loss in theory, in practice the difference is not so great owing to loss in the compression line and re-evaporation. If we examine condensing engine cards, we find the clearance loss still greater, owing to the effective pressure being so much higher. Taking card No. 8, first considered without clearance, with steam 80 lbs. gauge pressure, expanded 20 volumes, we obtain a M.E.P. of 15 lbs. Now if we expand the same volume of steam in a cylinder of the same area, but with 5% clearance, we find that the card shows the steam to have been cut off when the engine was on the centre. We get the same terminal and the same expansion line as in the first case, but the effective area is minus the initial pressure, giving only a M.E.P. of 10.5 lbs. instead of 15 lbs. as in the first case, showing a loss in power of 30% caused by 5°/₀ clearance. If we expand the same pressure to 10 volumes instead of 20, then the clearance loss is reduced to 16.66°/₀ ; if expanded 5 volumes, the loss is reduced to 9.55°/₀ ; and if only expanded to 3 volumes the loss is 7°/₀. The foregoing gives a general idea of the losses incurred by condensation and clearance, and their causes.

We will now devote a short time to the consideration of their remedies, commencing with condensation. This loss, as before stated, is caused by the fall in temperature of the metal of the

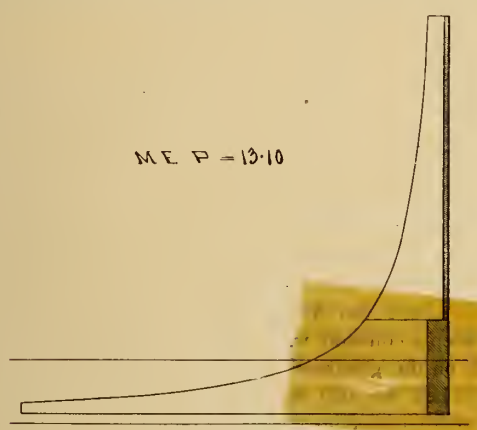


CARD NO. 8.

cylinder, consequent upon the fall in temperature of the steam during expansion (each stroke). If this fall in the temperature of the metal can be obviated, then the loss is overcome. To attain this end, steam jacketing has been resorted to—usually done by fitting a bush in the cylinder, a forced fit at each end—and arranged with a space between the bush and cylinder, the whole length of cylinder, and spaces cored in both covers ; these spaces are usually filled with steam at initial pressure, thus retaining the walls of the cylinder at nearly that temperature, and reducing condensation to a very great extent. But to attain the very best results where high ratios of expansion obtain, the jackets should be supplied with super-heated steam, at a higher temperature than that of the initial pressure. Another fact that

has been already mentioned in reference to loss by condensation is that the less the variation of temperature in a cylinder, or, in other words, the less the ratio of expansion, the less the loss. To this fact is very largely due the superiority of the compound or multiple cylinder engine over the single cylinder engine. For example, if we assume a case in which the low pressure is four times the area of the high pressure, we may obtain 16 expansions with only four expansions in each cylinder. In this way the high pressure cylinder works between limits of temperature, such as occasion comparatively small losses by condensation, and the low pressure cylinder works between the temperature of the exhaust from the high pressure cylinder and that of the condenser; these temperatures not varying very widely, the loss by condensation is correspondingly small. If the number of cylinders be increased, and the ratio of expansion in each reduced, then the condensation loss is still further reduced. Therefore, the loss by condensation may be almost entirely obviated by either steam jacketing or compounding, or both; and, at the same time, the economical advantages of high ratios of expansions obtained.

Referring to the second loss, viz., clearance, by analyzing its volume and effect we found, first, that the longer the stroke of the engine the lower the percentage of clearance volume for that



CARD NO. 9.

engine, and secondly, that the higher the M. E. P. developed in a given card the lower the percentage of loss by clearance in that card. It is an established fact that clearance is a source of loss; and also that the greater the percentage of clearance, the greater the loss, and, of course, the less the percentage of clearance, the less the percentage of loss; therefore the first point to be attained is to reduce the clearance volume to the lowest possible percentage; and the most successful way to do this is by adopting the long stroke engine.

To meet the second point, that is, to reduce the loss by clearance, we have found that the greater the M.E.P. of a given card, or the less the ratio of expansion, the less will be the percentage of clearance loss. If we attempt to reduce clearance loss in this way in a single cylinder, we are reducing one loss by reducing another gain, or trying to save steam by increasing the consumption of steam. But if we apply the same remedy that we have already applied to condensation, viz., compounding, we will find that it will have the desired effect. Although it may appear paradoxical to assert that by the employment of two or more cylinders (each having the average amount of clearance volume) to expand a given pressure, that the loss by clearance will be less than if the same ratio of expansion were carried out in a single cylinder, yet this is the fact, as I will endeavor to illustrate. For that purpose we will again refer to card No. 3, which represents steam at 80 lbs. gauge pressure, expanded to 20 volumes in a condensing engine, with 5°/₀ clearance. In this instance, the actual loss in power owing to clearance is 30°/₀ as compared to a theoretical card without clearance.

For purposes of comparison, we will assume card No. 9, in which the same volume of steam is expanded in a compound (or two cylinder engine), the low pressure cylinder of which is four times the area of the high pressure, and equal in area to the single cylinder referred to in card No. 8, each cylinder having 5°/₀ clearance. In this case the steam is cut off at 1-5 of the stroke in the high pressure, instead of 1-20 as in the single cylinder. ¾ of the initial pressure is used up to the point of cut off, is utilized as effective pressure in the H.P. of cards, whereas in card No. 8 the expansion only of the clearance volume is obtained as effective pressure. In the compound the low pressure card shows the full percentage of clearance, viz., 5°/₀, but the low pressure cylinder deals with such a short range of pressure that when it is averaged up with the total range it reduces the mean percentage very considerably. The high pressure cylinder being ¼ of the area of the low pressure, its clearance when referred to the low, becomes 1.25% instead of 5°/₀ the total effective height of the card, *i.e.*, from initial pressure to the back pressure line is 92 lbs. and the high pressure by card in expanding the initial pressure 5 volumes, deals with a range of 71 lbs. out of the 92. Now we can find the proportion the high pressure clearance bears to the combined card by multiplying 1.25°/₀ by 71, and dividing by 92; this gives .95, or 5-100 less than 1°/₀. To this we must now add the mean average clearance of the low pressure, which we find by the same rule, viz., 5°/₀ by 22, which is 4×92, which gives 1.14 as the average clearance. This, added to the high pressure, give us 2.09 as the percentage of clearance volume in the compound engine, as against 5°/₀ in the single engine of the same area as the low pressure of the compound—with same number of expansions in both cases, a reduction in clearance volume of 58°/₀ in favor of the compound engine, or in the case under consideration, an increase in power of 24°/₀. 5°/₀ clearance is high for a long stroke engine of large size. If we assume the clearance to be 2.5, which is quite possible, then the compound engine would reduce that to very little over 1°/₀. When we give due weight to these several economical advantages of the compound engine, we are in a better position to arrive at a just appreciation of its superiority over any class of single cylinder engines, and to account for the increased economy that results from its introduction, when properly designed and proportioned to its work. Apart from its economical advantages, it has another great advantage over the single cylinder engine where economy is attempted with high ratios of expansion, in that the power is much more evenly distributed throughout the stroke. If, for example, we refer to card No. 8, we find that at the beginning of the stroke the piston was subjected to a pressure of 92 lbs. per sq. inch, and at the end of stroke 1¾ lbs. only, with a M.E.P. of 10½ lbs., and as the strength of an engine in all its working parts must be in proportion to the greatest pressure to which it is subjected, then the weight of the working parts must be entirely out of proportion to the power actually developed, whereas in a cross compound, taking card No. 9 as referred to, the low pressure; on one end the initial pressure would be 21 lbs. and on the other end 18 lbs., reducing the initial thrust by about 78°/₀, or if considered as a tandem compound, the initial thrust would be only 39 lbs. as against 92 lbs. in the single cylinder, a reduction of 58°/₀ in the initial thrust to develop 24°/₀ more power.

THEORETIC CONSUMPTION OF STEAM.

Pressure.	Volumes.	Consumption.
150	20	10
200	30	9.5
400	40	8
800	40	7.5

Increased cost in fuel and condensation due to the high temperature.

QUESTIONS AND ANSWERS.

"A. T." asks: What horse power may be obtained from an engine with a cylinder 10 inches diameter, 12 inches stroke, and making 250 revolutions per minute, steam supplied at 60 lbs. pressure, or at 90 lbs. pressure? The point of cut-off is not given. This cylinder is 78.54 inches in area, the piston speed is 500 per minute. Assuming that the cut off is at one-third of the stroke, with 60 lbs. pressure on the piston at the beginning of the stroke the mean pressure will probably be 37 lbs. per sq. inch. Then

$$\frac{78.54 \times 500 \times 37}{33000} = 44 \text{ horse power.}$$

With 90 lbs. on the piston at the beginning of the stroke and the same cut off, the mean pressure would be about 55 lbs. Then

$$\frac{78.54 \times 500 \times 55}{33000} = 65 \text{ horse power.}$$

If the cut off is earlier or if the back pressure be unusually high, the horse power will be less than the above figures show.

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EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

SEAMLESS steel boats are now being made in Wakefield, England. They are made from a single steel plate about one quarter inch thick, and are no heavier than a wooden boat.

THE fifteenth convention of the National Electric Light Association of the United States will convene at the Iroquois Hotel, in the city of Buffalo, on the 23rd, 24th and 25th inst.

THE present winter is well calculated to put the electrical street railways in this country to a thorough test. From Ottawa word reaches us that the electric road in that city has demonstrated its ability to run against the elements. The cars are said to have run as regularly and perfectly with the thermometer at zero, as they did during the months of summer. The electric road has come to stay.

FLY wheels are usually made of cast iron, and may be subject to very severe strains caused by the contraction of the metal while cooling. Allowing a factor of safety of 10, it is calculated that the highest safe speed for the rim of a fly wheel is about 136 feet per second. An engine making 240 revolutions per minute, should have a wheel not more than eleven feet in diameter in order to be safe. The rim of such a wheel would travel about a mile and a half per minute.

AN excellent paper on "Losses in Automatic Steam Engines and Their Remedies," read by the author, Mr. Laurie, before the members of the Montreal branch of the Canadian Association of Stationary Engineers, is printed in full in this paper. It is understood that the Montreal Society have made arrangements for a series of papers on engineering subjects to be read at their meetings during the present winter. The readers of the ELECTRICAL NEWS will no doubt have the privilege of reading them. The enterprise of the Montreal society in this particular is deserving of emulation by branches of the Association in in other cities.

HERE and there will be found an engineer who gives as a reason for not becoming a subscriber of this journal, that considerable space is devoted to electricity, and he is not interested in electricity. It may not be possible to convince these persons that they are mistaken in their views, but such is nevertheless the fact. We unhesitatingly make the statement that every engineer in Canada requires an acquaintance with the principles of electricity, and the methods of its application. Not to recognize this fact means that some day positions to which he might have secured promotion, will be closed against him because of his lack of knowledge of electric appliances. The engineer who neglects now to fit himself for the changed conditions which electricity is bringing about in the manufacturing world, must expect to find himself relegated by and by to second and third rate positions with corresponding salaries.

A NEW invention in screw propellers for vessels is being experimented with at present in England. The object aimed at by the inventor is to produce a propeller which will always revolve in the one direction, and by means of which the motion of the vessel may be either forwards or backwards. With such a propeller the engine is much simplified, as it is unnecessary to have any reversing gear. The propeller is made with a centre hub, to which the projecting blades are so attached that they may be turned to form either a right hand screw or a left hand screw. The pitch of the screw may also be varied. Should this invention prove a success, it will make quite a change in the construction of marine engines, and will give the officer in charge of the ship as great control over the propeller as he now has over the helm. The engineer will only require to keep the engines going steadily, and by controlling apparatus, worked as the rudder now is, the propeller may be altered to change the speed or reverse the motion of the vessel.

ON January 7th, a little after 6 o'clock in the evening, a large new engine in a factory in Cincinatti became unmanageable and ran at such high speed that the fly wheel burst. The wheel is said to have been about thirteen tons weight, and one piece, about a ton weight, went up and came down again through the roof and three floors of the factory. Considerable damage was done, but fortunately no lives were lost. Something must have gone wrong with the governing apparatus, else the engine could not have run away beyond control. Every engineer should keep a constant watch on all the governing apparatus—not only on the governor itself and the driving gear, whether wheels or belt, but also on the valve which has to throttle off the steam, whether it be an automatic cut-off or not. Sometimes a separate valve is used to throttle the steam, and cases have occurred where this valve became loose on its spindle and was forced wide open by the steam, and of course in such a case the most perfect governor could do nothing. Such throttle valves should be made so that the pressure of steam will tend to shut them, and then if the governor fails to hold the valve open, the engine is stopped.

A DECISION of great importance to telegraph companies and operators and of much interest to the public, was pronounced a few days ago by the Court of Appeal in Montreal. The case was that of Laurance v. the Great Northwestern Telegraph Co. While Mr. Lionel Laurance was in New York one of his employees sent him a despatch saying, "Writing you to-night." The sentence was made to read, "Waiting you to-night." Consequently Mr. Laurance made an unnecessary trip from New York to Montreal and he sued the telegraph company for $200 damages. The court in the first instance awarded $30, the actual cost of the trip from New York. The company appealed from this decision. The fact was established that the error was due to the negligence of the employees of the company, but the appellant set up the plea that despatches were sent under a contract which declared that it would not be liable for damages resulting from errors unless the despatch was repeated, and then only to the amount of fifty times the amount paid for the message. Such a contract the court declared to be contrary to public policy, and any contract by which a party sought to fix the punishment for his faults was illegal. The judgment was confirmed.

AN amusing, and at the same time instructive incident, occurred quite recently in one of our neighboring cities, the like of which, it seems, may often be the cause of trouble, yet one would scarcely look for it in that direction. The meter inspector of the electric light company in making his usual rounds to take the readings for the monthly accounts, reported one of the meters (Shellenberger) as not having registered, although previous months had always shown up in good shape (for the

company). A repairer being sent to break the seal and remove the cover, found woven round the thin aluminium blades of the retarding mechanism, spider webs in all directions, but apparently not satisfied with spinning them from blade to blade, the spider had cast several hawsers from the blade to the back of the meter, thereby preventing it from being set in motion when the current was turned on. When they were removed, the meter started off in good shape again with but one lamp burning. The natural conclusion in such a case is that the spider had crawled into the meter when very small, and had made it his permanent abode until too large to crawl out again, but the problem is, what did he feed on?—surely not some of the current! Moral—if you want your meter bills to bring you in a proper return for the current supplied, have the covers removed from them every six months. In the case referred to, the meter had been undisturbed for more than a year.

HAMILTON, the "Ambitious City," who will be expected to wear her holiday attire during the convention of the Canadian Electrical Association there the coming June, will, we feel sure, be glad to welcome its advent, and be only too pleased to know that she is giving a good send-off to what may become one of the most influential institutions in the Dominion. Doubtless she will have her mountain all trimmed up in green, her bay wearing its best and cleanest apparel, and the weather the most propitious. *Apropos* of this, and for the benefit of those who have never paid a visit to this well-known city, we take great pleasure in saying it has many attractions that few other cities enjoy. Especially is this the case during the summer months. Among these attractions may be mentioned the mountain, the various drives, the glorious Hamilton (formerly Burlington) bay, the well-known Hamilton (formerly Burlington) beach, her beautiful, straight, block paved streets, arched over with shade trees, her comfortable, cozy homes, her congenial people, and above all, the thorough manner in which she tries to make all strangers within her gates enjoy themselves and have a good time generally. Other attractions will be the Electric Light and Power Company's new station, one of the most complete and best planned in the Dominion, the new City Hall and other public buildings, and the manufactories, the principal ones of which, we feel sure, will be thrown open for the inspection of the visitors. Apart from the above, Hamilton is one of the coolest and most home-like cities in the Province, in fact, just the sort of place to take the family along to spend a few days. We feel safe in asserting that all who attend the first annual convention of the Canadian Electrical Association in Hamilton, will have a right royal good time, and a brotherly welcome from her citizens generally.

TO those who have the care and running of dynamos of any description in their charge, we would say that dynamos and dirt can never be made to assimilate, no matter how hard one may try. Provided one expects his dynamos to do good service and cause little or no trouble, they should be looked after in this respect as particularly, if not more so, than is a steam engine by a good engineer, who knows what he may expect if he neglects this one matter in the handling of a steam engine. In fact, a dynamo room, from the switch board to the drip pans, should have no place for dirt in any form whatever. Particularly is this the case with the commutators and brushes of any class of dynamos, but more so with those that have open or removable segments. The writer has known of cases where arc dynamos of the T. & H. pattern were allowed to run for weeks at a time without the removal of the commutator segments, and when removed, the wonder was how they managed to hold out and give good results. It is almost criminal to have things in such a shape. The segments of which we speak should have been removed and thoroughly cleaned of their copper dust and oil at least every second day, which if properly attended to will reduce the liability of the current to jump through or perforate the insulations of the commutators to almost a nullity. Not only should dirt around the commutator be particularly guarded against, but a scrupulous cleanliness should be maintained over the entire apparatus. It will pay in every way to see that apparatus is not being loaded down with dirt. See to it that belts are kept clean both inside and outside; have them gone over at regular intervals by your belt maker, and have him remove all foreign matter from their pulley side with his thin steel scraper. We say have your belt man do it, because we feel sure that he will know just what to scrape off and leave your belt with a good hugging face for the pulleys. Also see to it that the pulleys on your line shafting are not whirling around nightly pound upon pound of grease and dust. In this connection it can be stated for a fact that recently a large friction grip pulley being used nightly to drive a large alternating machine, when ordered by a new manager to be cleaned, produced a full carbon box of filth; the rest of the pulleys also gave up their muck in proportion to their size. In view of such incidents it becomes not only a necessity, but an absolute charge on those operating electric light machinery, if they would have their plant in prime order, to see that dirt becomes no part of it. You can count on the loss of at least a pound of coal per hour for every pound of dirt that has to be whirled around by your engines. Another point that might be mentioned in this connection is, that none but the best lubricants should be used; they are the cheapest in the long run, and with the oil saving devices of the present day, you cannot afford to use poor ones; make it a point if you are not already fitted out with one, to procure an oil filter at once; be sure that it is a good one, and one that has stood the test; you can then afford to use none but the best quality of oils.

TO those interested in, or who contemplate purchasing an electric light plant, or making additions to an existing one, we would say, beware of the cheap trashy material and apparatus that is being landed at your door without more than a suggestion that you think of purchasing. By cheap, we do not mean those which are sometimes bought from a reliable manufactory at a very low price on account of keen competition—for any of the reliable manufacturing companies in existence to-day will sell the best they can produce, and will install it in a proper manner, even if they find that on account of the low price obtained they are sometimes unable to make but little profit thereby—but those which from the start are offered at a ridiculously low price, so low that the contemplative purchaser must know that it is away down, causing him sometimes to wonder if there has not been a mistake in quoting figures. Yet, when the seller assures him that the price is all right, he imagines he is getting as good as has been offered at perhaps twice the figure by a rival bidder for his contract, and not until he has the work all finished, the wirlng all completed, the engines and dynamos in running order, does the trouble begin to show itself; nor does he realize that the expense of keeping the thing in running order is going far beyond his expectations, until later on, when, after one or two incipient fires, he is notified by the Underwriters' inspector that to run the plant as it is installed will mean that he must run it at his own risk, without insurance. Then, and not until then, does he fully comprehend that he has been penny wise and pound foolish, and that it would have been better had he bought the more expensive plant at the outset. To make matters worse in cases of this kind, the concerns who do this low class work are generally so low down in their financial standing that it is worse than useless trying to make them do it over again and in a proper manner. The upshot of it is that the plant either has to be entirely removed and sold for little or nothing, or more money spent on it to put it in apple-pie order than would have been required in the first place had an A1 plant been purchased. It would be an easy thing, and not over-expensive, for would-be purchasers to find out for themselves before placing their orders, what is good and what is not. Instances have come under our observation where the entire wiring, &c., has been condemned by the insurance companies' inspector. One of the installations was done by a company who know how to do good work, but a cheap job was what was supposed to be wanted, and they filled the requirements; the other was done by a concern who do not know any better—who sell apparatus and do wiring without ever having had a day's instruction in such work; they do make a sale occasionally, but at what figures! There is another feature of the subject that it is far from our wish to encourage; that is, the excessively high prices and large profits which some of the larger electric manufacturing companies have been exacting from their patrons right along. In this direction, however, we are pleased to note a decided change for the better. They seem now to be aware of the fact that even 50 per

cent. profit on such articles as they turn out is far too much, and they are reducing their figures accordingly, in doing which they are assisting in the removal of the incompetents in the business in a way which is bound to result in an increase of their business and output. In conclusion we wish to say to those who are doing a manufacturing business, and who have the installation of a plant under their direction, see that everything is done in a proper and careful manner, and the best that can possibly be done. Have every large or small wire, be it for 1 lamp or 100, of the best material and put up in the proper way—in other words, do everything in your power to raise the standard of electrical work of all kinds, and nothing to lower it. Let money considerations be the last to think about when good work is placed on one side of the scale and bad on the other, for as sure as the sun rises and sets the bad will hit back every time.

MR. A. J. Corriveau, of Montreal, cut a prominent figure in connection with the recent National Electric Light Association convention at Montreal. Incidentally it might be mentioned that his prominence was not so much due to the value of his public services on that occasion as to the numerous articles inspired by himself which appeared in the American electrical journals, all tending to show that to him belonged the credit not only of securing the holding of the convention in Montreal, but also of the successful carrying out of the entire undertaking. In short, Mr. Corriveau got all the free advertising that it was possible for him to obtain out of his connection with the affair, and while with a liberal hand he assisted in the expenditure of public money subscribed for the entertainment of the visitors, he appears to have carefully refrained from drawing on his personal resources for that object. Therefore, if any person has special reason to regard with satisfaction the late convention that person is Mr. Corriveau. It was on this account that we read with less surprise than otherwise we would have done the announcement that at the recent street railway convention in Pittsburgh, Mr. Corriveau extended an invitation to the Street Railway Association to hold its next convention in Montreal. The invitation was not accepted, and for this Mr. Corriveau doubtless has reason to be thankful, inasmuch as the people of Montreal, whose hospitality cannot be doubted, might nevertheless have declined to allow him another opportunity of self-glorification at their expense. It may almost with certainty be said, that in thus professing to speak on behalf of the city of Montreal, Mr. Corriveau in reality represented no other person or interest than himself. If he would contribute handsomely to a settlement of the liabilities accruing from the late convention, he would stand in a better position to advocate a repetition of the event.

Another matter on which Mr. Corriveau has recently been expressing his opinion in the American electrical journals, is the attitude which those representing the electrical interests of Canada should assume towards the recently organized Canadian Electrical Association. He is a strong advocate of Canadians joining the American association. He thinks that thereby their interests would be better served. He is especially confirmed in this view since it was decided to change the name of the "National" to the "International" association. What advantages are to be conferred upon Canadians by this change in the name of the American organization he omits to mention. Of course the American papers are only too willing to publish Mr. Corriveau's opinions in this direction, while Mr. Corriveau is not slow to put his opinions on this or any other subject on record for the sake of the cheap notoriety which is thus afforded him. Mr. Corriveau is, of course, entitled to his opinions, but we submit that he has long enough posed as the representative of Canadian electrical interests, and hence, in vulgar parlance, is "called down." Mr. Corriveau never was and is not now entitled to speak on behalf of those interests. Touching the change of name of the American association, the opinion prevails on this side of the boundary that its object was to head off the movement for a purely Canadian organization. So far as the benefit to be derived by Canadians from membership in the respective associations is concerned, there is something to be said on both sides, but there is no doubt at all where the preponderance of advantage lies. Canadians for a time might derive more instruction from attendance on the meetings of the American society, but that is all that can be said. How many of such meetings, held say at one time in Boston, and at another time in Atlanta, Georgia, would Canadians be able to attend? What influence would the representatives of Canada be able to exert as members of the American association on behalf of the electrical business in Canada? To what extent would the American association have the power to influence legislation in Canada affecting the electrical interests of this country? Mr. Corriveau is kind enough to admit that "Canadian electrical interests are large enough to support an organization." So far he represents the feeling on the subject in this country. While it cannot be denied that in the United States there is, generally speaking, a more perfect development of electrical knowledge, we are nevertheless prepared to dispute the assertion of a New York contemporary that "all of the experience is on this side of the border." There are in Canada a few persons at least whose knowledge of the science is contemporaneous with its first application to commercial uses. As to the Canadian Electrical Association, it is daily gaining strength, and unquestionably has before it a career of usefulness. While preferring to exist as a distinctively Canadian organization, it has none but the kindliest feelings for the greater organization in the United States. Each of these associations has its own work to perform, and may each perform that work with the greatest possible efficiency and advantage to the interests represented. Meanwhile will Mr. Corriveau kindly refrain for a time from obtruding himself upon the notice of a forbearing public?

CANADIAN ELECTRICAL ASSOCIATION.

THE front page of this number of the ELECTRICAL NEWS is embellished with the portraits of the executive officers of the recently organized Canadian Electrical Association.

In future years, when the Association shall have become a large and influential body, as we believe it is bound to do, it may be a matter of some interest for its members to refer to the number of the ELECTRICAL NEWS containing the physiognomies of its original promoters.

It is with pleasure that we are in a position to state that interest in the Association is steadily extending. In another column is printed a letter from a resident of British Columbia who desires to becomes a member. In the possession of the Secretary is another letter of similar character from Edmonton, N. W. T., while a number of applications for membership from prominent representatives of the industry in Montreal and elsewhere are awaiting the action of the Executive Committee.

VALUE OF TRADE JOURNALS TO ADVERTISERS.

THE circulation of a trade paper concentrated among a special class entitles it to a higher advertising rate than the medium of general circulation. It is not worth more to every advertiser, but to those who wish to address the special class it reaches it is worth much more. The man who has an article to sell to druggists can afford to pay the best drug journal a rate higher than that charged by a paper circulating among all classes. The drug journal has practically sifted the community down to possible customers, and he pays for no waste circulation, as would be the case with any other medium. An inspection of the rate cards of the best trade papers shows that they uniformly charge rather high rates, and an inspection of their columns shows that they secure a much larger proportion of advertising than the mediums of general circulation. The conclusion is irresistible that advertisers find them to be worth what they charge.—*Printers' Ink.*

Wagg—We had a terrible thunderstorm as I came up in the train this afternoon.

Wooden—Weren't you afraid of the lightning?

Wagg—No; I got behind a brakeman.

Wooden—Behind a brakeman? What eartly good did that do?

Wagg—Why, he was not a conductor.—*Philadelphia Item.*

"Our old friend, Mrs. Ramsbotham, was reading the other day a letter in the *Times* about 'Electrical Tramways,' when she came upon a line stating that 'two naked conductors' would be used. Much shocked, she was about to look at something else in the paper when she noticed that 'one of the conductors was to be carried on poles and another to be 'laid rigid between the rails!' Horrified at this apparent brutality, the worthy lady has been writing letters (in draft) to the commissioner of police ever since."—London *Punch.*

THE ELECTRIC TRANSMISSION OF POWER.

By Gisbert Kapp.

(Continued from January Number.)

LECTURE II.—FUNDAMENTAL PRINCIPLES.

The fundamental principle on which the electric transmission of power depends is that peculiar, and, I might almost say, mysterious interaction between magnets and currents, which we comprise under the name electio-magnetic induction ; but more particularly two special cases of electro-magnetic induction, the one discovered by Oersted and the other by Faraday. Oersted discovered that, under certain conditions, a compass needle is deflected by an electric current, and Faraday discovered that relative motion between a magnet and a closed conductor will, under certain conditions, produce a current of short duration in the conductor. Oersted's effect is a permanent one ; the needle remains deflected as long as the current flows. Faraday's effect is transient ; the current flows, not as long as the magnet is present, but only during the time that it takes to change the relative position of magnet and closed conductor.

It is clear that in Oersted's experiment the movement of the needle is due to the action of a mechanical force between the magnet and the coil. In Faraday's experiment the transient current must be caused by a transient electromotive force, and this, in its turn, is caused by the relative movement between the coil and magnet. The modern method of explaining these things is based on the conception of magnetic lines of force, and the looping of these lines with the wire coil through which the current flows. The whole subject has been so admirably laid before this Society in the Cantor Lectures on the Dynamo, which Prof. S. P. Thompson delivered here in 1882, that I need not occupy time by going over the same ground again, but may take it for granted that you are familiar with the lines of force theory. In modern language, we may therefore explain the two fundamental phenomena somewhat as follows :—

1. The looping of a current with magnetic lines of force sets up a mechanical force between the conductor and magnet (or its equivalent).

2. Relative movement between a magnet (or its equivalent) and a wire coil sets up in the latter an electromotive force.

It follows immediately from these two propositions that looping and movement combined will require the expenditure of power, or yield power, accordingly as the movement is opposed to, or in the direction of, the mechanical force produced by the looping. In other words, that we can, by these simple means, convert mechanical into electrical power, or electrical into mechanical power. If we carry out both processes at the same time, that is, if we combine Faraday's with Oersted's experiment, we require, of course, a pair of wires between the two converting instruments. In Faraday's experiment, if we thrust the steel magnet into the wire coil, we expend mechanical power, which

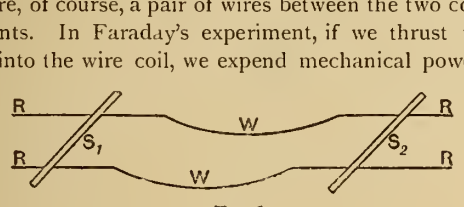


Fig. 1

is converted into the electrical power represented by a current flowing under a certain, though in this case very small, potential difference. The power represented by this current is again reconverted in Oersted's experiment into mechanical power, which is used to produce the deflection of the magnet. The total amount of power thus transmitted from one place to another is, of course, exceedingly small, but the same principle, applied on a larger scale, effects the transmission of many horse-powers, and it will be my task to show you how this is done in practice.

Before entering upon this subject, I must explain an expression used in stating the fundamental principles on which the electric transmission of power is based. I said that we require a coil and a magnet "or its equivalent." The equivalent of a magnet is, as you know, a coil through which a current flows, and the experiments ought, therefore, also to succeed if instead of a magnet we use such a coil. In practical work we use neither a steel magnet nor a coil alone, but a combination of a coil with an iron core, constituting what is known as an electro-magnet.

You know that, according to our modern conception of magnetic fields, there emanates from each pole of a magnet a certain flow of lines of force ; and when we thrust a magnet into a coil we cause the individual wires of the coil to cut through the lines of force. The quicker the movement, that is to say, the more lines of force are cut by each wire in unit time, the greater is the E.M.F. produced ; and the more wires are contained in the coil, the greater is the E. M. F. produced, since the E. M. F. impulses of the different convolutions are added. It is also

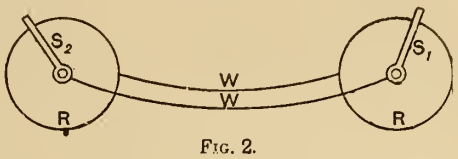


Fig. 2.

easily seen by experiment that the stronger the magnet the greater will be the E.M.F.; so that we find that the E.M.F. is proportional to the product of strength of field, speed of cutting, and length of conductor. Denoting these quantities respectively by H, v, and l, the E.M.F. produced is in C.G.S. units $H\,v\,l$, and remembering that a hundred million C.G.S. units of E.M.F are equivalent to one volt, we have the E.M.F. in volts given by the expression

$$\text{Volts} = H\,v\,l\,10^{-8}.$$

In this formula the strength of field is given in lines per square centimetre, and speed and length are given in centimetres.

The mechanical force experienced by a conductor in the neighborhood of a magnet pole is, according to our modern views, due to the fact that the conductor is laid across the lines of force emanating from the magnet pole. The force in dynes is given by the product, $H\,c\,l$, c being the current. Since there are 981,000 dynes required to represent the force of one kilogramme, and since the C.-G.-S. unit of current is 10 amperes, we have the force produced by a current of c amperes—

$$\text{Kilogrammes} = \frac{H\,c\,l}{9{,}810{,}000}.$$

These are the two fundamental equations required in the design of plant for the electric transmission of power. Now let us see what is the most simple kind of plant we could possibly employ. At the generating station we require a conductor cutting lines of force ; this conductor must be joined by wires with a similar conductor at the receiving station. The second conductor is also laid across lines of force, so that when a current passes it will be acted upon by a mechanical force displacing it parallel to itself and doing work. The arrangement here described is shown in Fig. 1, where the lines R represent fixed, horizontal, parallel rails, across which are laid sliding rails or sliders, S^1, S_2. Imagine the magnetic lines of force passing vertically between the fixed rails, then, if we displace the slider S^1, an electromotive force will be set up in it, causing a current to flow through the connecting wires, W, and the slider S_2 at the receiving station. The slider S_2 is supposed to be laid across lines of force, and will, therefore, be acted upon by a mechanical force. Thus, power may be electrically transmitted from the slider S_1, to the slider S^2. It will immediately occur to you that the experiment I have here illustrated could easily be tried by means of any railway. The fixed conductors and connecting wires would be the rails ; the generating slider would be a crowbar thrown across them, and hauled along by a train ; and the lines of force would be supplied by the vertical component of terrestrial magnetism. At another part of the railway—possibly miles away—another crowbar thrown across the rails should then be set in motion, by the current passing through it. Theoretically, such an arrangement represents correctly enough the electric transmission of power ; but I need hardly tell you that it would not work in practice. If you apply the E.M.F. formula I have given to this case, you will find that, even if the slider is hauled along at the speed of an express train, there will only be generated about the one-thousandth part of a volt, the reason being that the magnetic field provided for us by nature is so extremely weak. If we could apply an artificial magnetic field of the strength generally employed in dynamo machines—that is, about 10,000 times as strong as the vertical component of terrestrial magnetism—then we could get about 10 volts in our slider. Now, it is obvious that we cannot spread so strong a field over miles of railway ; and we must, therefore, alter our arrangement. This may be done as indicated in Fig. 2, where one of the rails has been replaced by a

centre contact, and the other by a circular conductor. The slider, instead of being moved parallel to itself, must now revolve round the centre contact, which can easily be done by a belt and pulley. We have thus arrived at was is known as a non-polar dynamo. But even this arrangement, although very much better than the progressive slider, is not of practical value for power transmission, because the E.M.F. of non-polar dynamos is still too low. It is only a few volts, whereas we require hundreds, or even thousands, of volts to carry the current to any distance. The obvious remedy is to use a large number of revolving sliders, so connected that the E.M.F. generated in each shall be added; in other words, instead of a non-polar dynamo, we must use an ordinary continuous current dynamo, wound for high E.M.F. This arrangement is shown in Fig. 3,

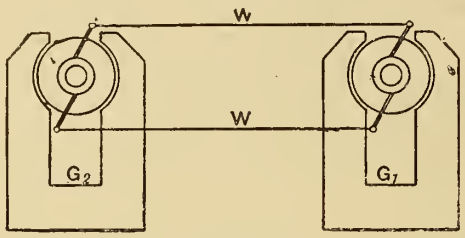


FIG. 3.

where G^1 is the generator and G^2 the motor or receiving dynamo. If you connect their brushes, as shown in the diagram, and rotate the armature of the generator, a current flows through it, the line wires W, and through the armature of the motor, and exerts upon the latter a mechanical force, tending to produce rotation and give off mechanical power. I am able to show you this experimentally, by means of two dynamos connected, as shown in Fig. 3.

The Machines Employed in Power Transmission.

This experiment has shown how power may be transmitted electrically. Let us now consider somewhat more in detail the different parts of the transmitting plant. At one end of the line of transmission we have the generating dynamo, at the other we have the motor dynamo, and then we have the line itself, consisting of two wires insulated from each other and from earth. You will readily see that although for the convenience of experimental illustration I have placed the generator and motor close together, this proximity was not an essential condition of the experiment. The motor might have been placed in another room, or in a different part of London, and still the experiment would have succeeded, provided I had used sufficiently stout and well-insulated connecting wires. But then you could not have had ocular demonstration of the fact that movement of the generator armature is closely followed by a corresponding movement of the motor armature.

A full treatment of my subject would, of course, include a complete investigation of the dynamo, but this I shall not attempt. In the first place there is no time for it, and in the second place it is hardly necessary, since you are all more or less acquainted with these machines. I shall, therefore, not occupy time by giving mathematical proofs for the few formulæ I shall have to use, but assume they are familiar to you. They are as follows:—

$$\text{Volts} \ldots\ldots\ldots = H\, v\, l\, 10^{-8}$$

$$\text{Kilogrammes} \ldots = \frac{H\, c\, l}{9{,}810{,}000}$$

C Total current through armature; c, current through single armature conductor.

e^a E.M.F. in armature in volts.

r Number of active conductors counted all round armature.

p Number of pairs of poles ($p=1$ in a two-pole machine).

n Speed in revolutions per minute.

F Total induction in C.-G.-S. lines.

Z " " English lines.

Electromotive force:

$$e_a = F\, r \frac{n}{60} 10^{-8} \quad \text{for two pole-machines.}$$

$$e_a = Z\, r\, n\, 10^{-6}$$

$$e_a = p\, F\, r \frac{n}{60} 10^{-1} \quad \text{for multipolar machines with series-wound armature.}$$

$$e^a = p\, Z\, r\, n\, 10^{-6}$$

Torque ....

$$\left.\begin{array}{l} \text{Kilogramme-metres} = 1{\cdot}615\, F\, r\, C\, 10^{-10} \\ \text{Foot-pounds} \ldots\ldots = 7{\cdot}05\, Z\, r\, C\, 10^{-6} \end{array}\right\} \text{for two-pole machines.}$$

$$\left.\begin{array}{l} \text{Kilogramme-metres} = 3{\cdot}23\, F\, r\, c\, p\, 10^{-10} \\ \text{Foot-pounds} \ldots\ldots = 14{\cdot}10\, Z\, r\, c\, p\, 10^{-6} \end{array}\right\} \text{for multipolar machines.}$$

In analyzing these formulæ you will observe a curious parallelism. The symbols for field strength and total number of active armature wires occur in either group, but the current occurs only in the group giving torque, or mechanical turning effort, and the speed occurs only in the group giving E.M.F. Now, if you multiply any of the torque formulæ with the speed you get on the left—mechanical power; and on the right the product of electromotive force, multiplied with current and a constant, or, in other words, electrical power; by working this out in figures, you will find that mechanical energy expressed in horse-power is equal to watts divided by 746, the well-known equation for converting mechanical into electric power.

The formulæ are equally applicable to cylinder armatures wound gramme fashion and to drum armatures, provided we count not turns of wire but active conductors over the whole circumference of the armature. As regards two-pole machines, the formulæ are the same as found in every text-book on dynamos, but as regards multipolar machines, a little explanation is required, both as to the winding and as to the advantage or otherwise of using more than one pair of poles. To make the explanation clear, I must refer for a moment to the ordinary method of drum winding for two-pole armatures. When such a winding is illustrated in a text-book, the author takes care to show only very few conductors, for the simple reason that the diagram would be one unintelligible maze of line if it were drawn so as to represent an armature as really made. To get over this difficulty I employ, instead of a diagram, a tabular statement of the winding such as you see on the wall. This particular table represents the winding of a drum armature having 100 active conductors.

Drum Winding.

F	B	F	B	F	B	F	B	F	B	F
D	U	D	U	D	U	D	U	D	U	
100	49	– 98	47	96	45	94	43	92	41	
90	39	88	37	86	35	84	33	82	31	
80	29	78	27	76	25	74	23	72	21	
70	19	68	17	66	15	64	13	62	11	
60	9	58	7	56	5	54	3	52	1	
50	99	+ 48	97	46	95	44	93	42	91	
40	89	38	87	36	85	34	83	32	81	
30	79	28	77	26	75	24	73	22	71	
20	69	18	67	16	55	14	63	12	61	
10	59	8	57	6	55	4	53	2	51	
100	49	– 98								

The figures at the top of the vertical columns indicate the direction of winding, supposing the winder looks at the armature end on. The letter D signifies a wire, wound down or away from him; and the letter U a wire wound up or towards him, The letters F and B, placed between the others, denote the front and back connections respectively. In modern machines these connections are not made of flexible wire, but are separate pieces, specially made to shape, and are generally of larger section than the conductor. so as to reduce the resistance of the armature as much as possible. One form of connector is on the table, both in pieces and built up. By referring to the winding-table, you will see that every wire is numbered; and thus we can see at a glance how the ends of each wire are connected. The table on the wall refers to a two-pole machine, that on the slip in your hands to an eight-pole machine, wound so as to obtain the E.M.F. of the four pairs of poles in series. The printed table, giving the eight pole winding, is almost self-explanatory; but, to assist you in understanding the winding of these multipolar machines generally, I had this model prepared, showing a few of the conductors of a six-pole armature. This method of winding has been invented by Messrs. Scott and Paris, patents 4,683 and 6,261 of 1874. There are no internal cross-connections, the ends of the conductors being joined simply by connecting segments of the kind I have just shown you; but with this difference, that each segment, instead of embracing half a circle, embraces only one-sixth of a circle. The winding goes in zig-zag, so to speak, round the armature,

returning to the second wire in front or behind the previous starting-point. There are thus only two brushes required. The winding tables show, also, very clearly how the E.M.F. increases from wire to wire, and that the greatest difference of potential occurs between neighboring wires at the diameter of commutation. The difference of potential between neighboring connector segments, is, however, limited to the E.M.F. due to the two conductors. The winding is used for machines intended to give high-pressure currents, such as are required in power transmission. Where low-pressure and large currents are required, the winding is altered, so as to form overlapping loops on the armature, and for intermediate electromotive forces a combination of both methods can be used. But as these windings have no immediate importance for power transmission, I shall not detain you with a description of them.

Table of Winding for 8-pole Drum Armature; 202 Conductors; Series Winding; Brushes (+) 135° apart.

F	B	F	B	F	B	F	B	F
D	U	D	U	D	U	D	U	
202	25	50	75	100	125	150	175	
200	23	48	73	98	123	148	173	
198	21	46	71	96	121	146	171	
196	19 −	44	69	94	119	144	169	
194	17	42	67	92	117	142	167	
192	15	40	65	90	115	140	165	
190	13	38	63	88	113	138	163	
188	11	36	61	86	111	136	161	
186	9	34	59	84	109	134	159	
184	7	32	57	82	107	132	157	
182	5	30	55	80	105	130	155	
180	3	28	53	78	103	128	153	
178	1	26	51	76	101	126	151	
176	201	24	49	74	99	124	149	
174	199	22	47	72	97	122	147	
172	197	20	45	70	95 +	120	145	
170	195	18	43	68	93	118	143	
168	193	16	41	66	91	116	141	
166	191	14	39	64	89	114	139	
164	189	12	37	62	87	112	137	
162	187	10	35	60	85	110	135	
160	185	8	33	58	83	108	133	
158	183	6	31	56	81	106	131	
156	181	4	29	54	79	104	129	
154	179	2	27	52	77	102	127	
152	177	202						

Now, as to the advantage of multipolar machines, such as the one which I illustrated on the screen. The field magnets are arranged perfectly symmetrical round the armature; and thus the one-sided magnetic pull, consequent upon the employment of a single pair of horse-shoe magnets, is avoided. There is very little magnetic leakage, the machine being what is known as iron-clad; and, as I have already shown, the E. M. F. is equivalent to that of several smaller machines, coupled in series. The internal diameter of the armature is very large, affording plenty of space for the ingress and egress of air; and the weight of the machine is less than that of an equivalent two-pole machine. The most important advantage, however, is the small armature reaction. Experience with large two-pole machines has shown that there is a limit to the size above which such machines are satisfactory. This limit depends, of course, on the speed and voltage, as well as on the output; but, roughly speaking, we may take it that, for moderately high voltage, and an output above 100 H.P., the multipolar machine is preferable; and we find, accordingly, that, for the transmission of large powers, multipolar machines are, as a rule, employed.

I have hitherto not made any distinction between motors and generators, because the difference between them is almost negligible. There are certain secondary effects which may be a little greater in one machine than in the other; but these are of so little importance that it will not be worth while to devote any time to their consideration. As a rule, a good generator makes a good motor. All we require to do is to set the brushes a little forward of the neutral line in the former, and a little back from that line in the latter. Now let us see what it is we must naturally aim at in putting up a transmission plant. At the generating end of the line we want as high an E.M.F. as we can get, because a high E.M.F. means large power and small percentage loss due to line resistance. At the motor end we want as large a torque or statical effort as possible, combined with a certain speed. But a glance at the formulæ will show that it is impossible to get speed without also getting E.M.F., which, in the case of the motor, must oppose the current, and thus the current actually flowing through the motor is that due to the difference between the E.M.F. of the generator and the counter E.M.F. of the motor. This difference, divided by the total resistance of the circuit, gives the current.

The electrical power developed in the generator is the product of this current, and the E.M.F. in its armature. The electrical power converted by the motor is the product of the same current and the counter E.M.F. of its armature. It therefore follows that the electrical efficiency of the whole system is given by the ratio between the generator and motor E.M.F. The more nearly alike these two are, that is to say, the less E.M.F. lost in resistance, the greater will be the electric efficiency. Now, the smaller the current the less E.M.F. is lost in resistance; but to get power with a small current we must work at high pressure, and we thus find that, from the point of view of electrical efficiency only, the higher the voltage the better. There are, however, other things to be considered besides electrical efficiency, and if we take due account of these we find that for every case there is one particular voltage at which it is best to work.

Upon this subject I shall enter presently, but, before doing so, I must place before you some points in connection with the regulation of speed and power in transmission plants. Unless we can control the speed, and regulate the power given out at the receiving end of the line, the most perfect motor or the most efficient system is useless. Fortunately, however, electricity is not only a powerful transmitting agent, but also one that can be easily controlled, and my next task is to show you how this control is effected.

(To be Continued.)

PERSONAL.

Mr. A. A. Dion recently resigned his position as chief electrician of the Intercolonial railway at Moncton, N. B., to accept the management of Messrs. Ahearn & Soper's establishment and the secretary-treasureship of the Chaudiere Electric Light and Power Co., at Ottawa.

Mr. H. Q. Moysey, assistant electrician of the Toronto fire alarm system, died of pneumonia, superinduced by an attack of la grippe, on Sunday, Jan. 17th. Mr. Moysey was born in Devonshire, England, 52 years ago, and came to Canada about 1871. He was first employed by the old Montreal Telegraph Co., but had been in the city's employ for some years.

In recognition of the valuable service he has rendered on behalf of the Commercial Cable Co., in which many Canadians are interested, a banquet and a solid silver service valued at $3,000 were recently tendered to Mr. Chas. R. Hosmer, general manager of the C.P.R. Telegraph Co., and a vice-president of the Commercial Cable Co., at the St. James Club, Montreal,

PUBLICATIONS.

We have received with the compliments of the American Electrical Works, Providence, R.I., a souvenir of the recent N.E.L.A. convention in Montreal in the form of a large photograph showing a group of the leading spirits both American and Canadian in connection with that event.

The February *Arena* will be read with interest by thoughtful people. Its papers are all readable, many of them very strong. Briefly, the contents are as follows: Frontispiece, Herbert Spencer, a very fine portrait of the great philosopher. Herbert Spencer's Life and Work, by W. H. Hudson, for many years Mr. Spencer's private secretary; Danger Ahead, a thoughtful discussion of the electoral college problem, by Robert S. Taylor; The Railroad Problem, by Ex-Gov. Lionel A. Sheldon; The Soliditary of the Race, by Henry Wood; Hypnotism and its relation to Psychical Research, by B. O. Flower; Inspiration and Heresy, by P. Cameron, B.C.L.; The Sub-Treasury Plan, by C. C. Post, author of "Driven from Sea to Sea"; The Atonement, by Rev. Burt Estes Howard; The Last American Monarch, by James Realf, Jr. "A Spoil of Office," part second of Mr. Hamlin Garland's great novel of the modern west.

The British Columbia District Telegraph and Messenger Service Co., of Vancouver, will establish services in Nanaimo and New Westminster.

The plans adopted for lighting the buildings and grounds of the World's Columbian Exposition provide for 138,218 electric lamps, of which 6,766 are to be arc lamps of 2,000 candle power each, and 131,452 incandescent, 16 candle power each. The electric lighting will cost something like $1,500,000, and will be ten times as extensive as was employed at the Paris Exposition. The light and motive plant at the Exposition, it is estimated, will require 26,000 horse power, of which 22,000 will be required for the electric plant.

ANNUAL DINNER OF MONTREAL BRANCH, C. A. S. E.

THE Reindeau Hotel, Montreal, was the scene of rare good fellowship on the evening of Saturday, Jan. 23rd, when the members of the Canadian Association of Stationary Engineers of that city and invited guests assembled around the festive board to celebrate their annual reunion.

The attendance outnumbered that of previous years, about one hundred being present. The management of the hotel exerted themselves most successfully on behalf of the enjoyment of their guests.

The Committee of Management, Messrs. T. Naden, President of the Society, T. Ryan, F. H. Thompson, H. Nuttall, R. Doran, Jas. Elliott, and Jos. G. Robertson, the efficient secretary of the Association, left nothing undone which might contribute to the happiness of the occasion. The "regulation," "lubrication" and "adjustment" were so perfect that while "noiselessness" was not altogether secured, "hot boxes," "pounding," or anything tending to disturb harmony were conspicuously absent.

Mr. Geo. Hunt occupied the chair, and proved himself to be well-versed in the duties of a "governor"—more especially a governor of a feast.

Letters of regret at inability to attend were read from Professors Bovey and McLeod, Messrs. H. Valance, H. M. Sweetland (New York), Mayor McShane, E. O. Champagne, Fred Thomson and C. E. Robertson.

After due attention had been paid to the many delicacies with which the tables were loaded, the usual patriotic toasts were honored.

In response to the toast "Mechanical and Steam Engineering," Capt. Wright spoke as follows:—

"It is with great pleasure that I have the honor of meeting you at your second annual dinner. I believe in such things. The civil engineers have theirs, why not the stationary engineers? For a few hours once a year you can cast aside care. Low water in the boiler or steam down makes no difference for the time being. I was amused a year ago at overhearing a conversation between two members of this society. The first annual dinner was close at hand. "Are you going?" said one to the other. "No," was the reply. "Why not?" "Because I never attended such a thing, and don't know how to behave." I felt humiliated. But by this acknowledgement, the speaker at least proved himself capable of learning. I was sorry that such feelings existed. The behaviour at a public dinner—whether we feed ourselves with the fork or the knife, whether we put the spoon to the mouth sideways or pointways, or whether the tea spoon should remain in the cup or be put in the saucer—we engineers must leave these highly important, momentous and abstruse questions to the cultivated and high toned society gentleman, who alone is able intellectually to grasp the situation. We engineers will content ourselves with the rule of the engine room that the most direct and simple method is the best, at table or elsewhere. A few days ago, circumstances brought your society in a forcible manner to my mind. A free public lecture was given under your auspices by Mr. Laurie, on "Improvements on the Steam Engine." It was duly advertised in the papers, and a large representative gathering was present. An able paper was read on the subject, which was appreciated by all present. The following day I saw a notice in two of the English dailies that such a thing had taken place—all done up in space of four or five lines—while in the same papers whole columns were dished out to us about contests at billiards, "An Angle in an Ulster," pugilism and dogs. It is said, and I believe it with truth, that the moral and intellectual standing of a community can be correctly estimated from their newspapers. What would intelligent strangers or foreigners think of us in view of such a showing? In defence it might be said that a paper is run to please its patrons. Granted; but I have no doubt that fifty copies of the daily papers are sold to the engineers and mechanics of this city for every one sold to the slugging, plugging and gambling fraternity; and I will include the owners of St. Bernard dogs, which were honored on that occasion with a column and a half.

Mr. Chairman and gentlemen, the engineer is one of the most important factors of the present time. There are several meanings to the term "Engineer," or more properly speaking, several branches in the department of engineering. I confine myself to the word as used in the name of your society. One doctor may have the lives of a dozen persons in his hands. An engineer may have a thousand. Put all of our lawyers, notaries, brokers, shavers, boodlers, aldermen, etc., etc., that ever have, or ever will exist, in a bag, shake them up and riddle them in a riddle—what have they done for the benefit of their fellowmen or the country in comparison with the work of one engineer known as James Watt? He has revolutionized the world and changed its geography in a peaceable manner by giving us "power." As a consequence, the wages of the workingman have doubled and trebled since his time, and the necessaries of life are much lower in price since 1792; we are better fed and better clothed; live longer and enjoy ourselves more. The child born this year, if he lives to be 60 years of age, will live more, see more and do more, than if he had lived 969 years in the time of Methuselah. The railroad and the steamship are the great christianizers and civilizers of the day. Should thousands of missionaries be sent to Africa, they would not civilize the nation as fast as would a railroad through the country. What are the results following engineering in our own country? I can get a suit of clothes of English or Canadian material in Ontario for the same or less money than here in this city, depending upon municipal or other taxes. The farmer 500 miles from here gets within a few cents per bushel of the price for his grain alongside of the ship in Montreal. These are some of the doings of the engineer and his engine. What will take place in the next fifty years it is impossible to forsee. The engineer can work, but he can not prophesy."

"The Manufacturing Interests" were responded to in suitable terms by Messrs. Laurie and Darling.

Messrs. Smellie and Naden did likewise on behalf of the toast to "Electrical Engineering."

Mr. Grandberg replied on behalf of the toast "License Law and Inspection."

"The Brotherhood of Locomotive Engineers" found an able representative in Mr. Clark.

Messrs. Gormley and Mitchell replied on behalf of "Our Guests," and Mr. J. B. Mortimer, of the ELECTRICAL NEWS, on behalf of "The Press."

Several recitations and songs were creditably rendered by Messrs. Hunt, Nuttall and Naden.

An invitation was extended to the members of the society by Prof. Bovey, on behalf of McGill University to pay a visit to that institution, when Prof. Nicholson has kindly promised to explain to them all the latest improvements in apparatus employed in teaching applied science. It has been decided that in response to the invitation so kindly extended the Association will visit the University on Saturday next, the 6th inst.

Capt. Wright also promised to read a paper on "Power" at the next regular meeting of the Association, on Feb. 11th.

An evening of unusual enjoyment was brought to a close shortly after midnight.

TRADE NOTES.

The Toronto Electrical Works report business extraordinarily good for the season. They have been making a large number of repairs to armatures, converters, &c., having special facilities for this class of work. They are also Canadian agents for the justly celebrated Stanley converters. The "tried and true" Clark rubber covered wire is a specialty of theirs, of which they handle large quantities. In the general supply line they have been and are very busy. In the construction and expert department they have been pushed to meet demands. They are making a specialty of reconstruction or extension of present plants and of expert inspection.

Within the last three months the Royal Electric Company, of Montreal, have manufactured and installed the following electric lighting and power plants: Quebec & Levis Electric Light Co., 1500 light alternating dynamo; The Prince Albert Electric Light & Power Co., 500 light alternating plant complete, with transformers, lamps, meters, &c.; Corporation of New Westminster, B.C., 50 light arc dynamo complete, with lamps, etc., and 1500 light alternating incendescent plant, with transformers, lamps, meters, etc.; School of Practical Science, Toronto, 25 light direct current dynamo; Standard Electric Co., Ottawa, two 1500 light alternating dynamos, three 75 h. p. power generators, 75 h. p. motor, two 15 h. p. motors, two 10 h.p. motors, 7½ h.p. motor and two 5 h.p. motors; Messrs. J. C. Wilson & Co., Montreal, 250 light direct current incandescent plant, complete; Messrs. Wells, Richardson & Co., Montreal, 7½ h. p. motor; Canadian Pacific Railway Co.'s new shops at Hochelaga, 35 light arc plant, complete; Grand Trunk Co.'s new rolling mills, 15 light arc plant, complant, complete; Messrs. G. A. Mooney & Co., 100 light direct current incandescent plant; Henry Owen, Montreal, 2½ h. p. motor; J. B. Robert, Beauharnois, Que., 150 light direct current dynamo; Alex. Buntin, paper mill, Valleyfield, Que., 150 light direct current plant; Lachute Electric Light Co., Lachute, Que., 350 light alternating plant, complete; Canadian Bridge & Iron Co., Montreal, 15 light arc plant; Royal Pulp & Paper Co., East Angus, Que., 350 light alternating plant, complete; Geo. Hilliard, mills, Peterborough, Ont., 150 light direct current plant, complete; Edmonton Electric Co., Edmonton, N.W.T., 500 light alternating plant and the necessary steam plant complete; Coaticooke Electric Co., Coaticooke, Que., 350 light alternating plant; Wm. Ewing, grain warehouse, 5 h p. motor; The Granite Mills, St. Hyacinthe, Que., 35 light arc plant, complete; Dominion Wire Mfg. Co., Montreal, 300 light direct current dynamo, and the P. E. Island Electric Co., Charlottetown, P.E.I., 500 light alternating plant, complete. This, for a purely Canadian institution, speaks volumes for the enterprise and push of the management, and especially so when the heavy competition from every large American institution is taken into consideration. A number of these plants have been increased, principally the Quebec & Levis Electric Light Co., the corporation of New Westminster, the Standard Electric Co., the Dominion Wire Mfg. Co., the P. E. I. Electric Co., the Granite Mills and the C. P. R. Besides the above the Royal Electric Co. have installed some 8000 lights with corresponding engine and dynamo capacity in their own lighting station in the city of Montreal. The Polson Iron Works Co. are now building for them in Toronto, two large engines, one of which is a 750 h. p. double compound engine and the other a 500 h.p. They are installing four batteries of Babcock & Wilcox boilers, each of a capacity of 300 h.p., and are building a large factory and lighting station, thereby doubling their present output.

ASSOCIATION OF MARINE ENGINEERS.

AT the last regular meeting of the above Association the following officers were elected for the ensuing year: President, F. E. Smith, by acclamation; 1st vice-president, E. W. Fox; 2nd vice-president, P. J. Kennedy; council, R. Hughes, S. Gillespie, D. L. Foley, J. J. Kennedy, P. Quinn; treasurer, J. H. Ellis, by acclamation; secretary, S. A. Mills, by acclamation; inside guard, J. Adams; auditors, J. Harrington and J. D. Banks.

Winnipeg, Manitoba, possesses a telephone exchange which has over 750 subscribers—one to every thirty-six of the population. Such facility of communication, *Practical Electricity* thinks, "must tend greatly to the increase of family gossip, and it would be interesting to know how far this conpition tends to cordial relations in the community. If the difficulties of obtaining the ear of "Central" and completing an interview over the wire without interruption are anything near what they are in most telephone exchanges, there must be great self-control practised, or a canvasser for a vocabulary of objurgatory phrases would be favorably received. In London, England, where telephone service has recently been reduced to ten pounds a year, the attendants at the central stations wear sounders on their heads, and no bell is rung—the taking of the phone by the user producing a sound that is faint, indeed, but sufficient to call the girl's attention. In consequence, the room is less noisy than by the methods which have hitherto prevailed, with, probably, less confusion of sounds over the wire than is usually met with."

STEAM TURBINE TESTS.*

Our cable dispatch this week contains what to electrical engineers will appear a most remarkable and sensational experiment. It is the result of a careful test made by Prof. Ewing on a steam turbine and dynamo combination of 100-kilowatt capacity. The Parsons turbine has been known for some years, and has been given a considerable trial on a small scale. The excellence of the result of this last test, however, was hardly to be anticipated, even by the most visionary friends of the steam turbine. It was found that at full output an electrical horse-power hour could be obtained by the consumption of only 27.6 pounds of steam, while at half load but 29 pounds were required. If his result is confirmed, and there is reason to expect that it will be on account of the well-known skill of the engineer who made the tests, its effect may prove to be very far-reaching. Nearly a year ago in discussing an American invention of a similar character—the Dow steam turbine*—we called attention to the wide field of usefulness that would be opened to such an apparatus if it should be found reasonably economical of steam. The present facts show not only reasonable but extraordinary economy, for 27.6 pounds of steam per horse-power is a figure that, it is safe to say, has never been reached by any simple high speed engine of the type of which there are thousands in use in electric light and power stations to-day, and is barely within reach even of compound engines when they are used non-condensing. And still more remarkable is the half-load efficiency, If either the Parsons turbine or its American compeer can give such results as this with the regularity that it is fair to anticipate in view of such favorable tests, the simple engine has found a competitor more formidable than even the most sanguine of engineers has felt justified in expecting. For not only is the steam turbine economical but it is cheap to build, occupies an exceedingly small amount of space, and is unusually free from mechanical complications. Furthermore, the high speed desirable in its use tends to the production of an extremely economical type of dynamo. High speed is the most efficient way of getting high voltages, so that the very conditions which have given such good results in the prime mover are most favorable to the dynamo itself. A 100-kilowatt steam dynamo of the type we are considering is a much smaller and cheaper machine than any similar combination which has as yet been devised, and quite capable of playing a most important part in central station equipment. The enormous output in proportion to the weight will render it desirable for marine use, while the immense economy of space gained at the same time will tell in its favor everywhere. It is hard now to estimate the importance which this new development in prime movers may assume. It certainly means active rebellion against small high speed engines, and may extend to open revolution against our present methods of central station practice.—*Electrical World.*

NOTES.

The maximum safe velocity of solid cast-iron fly wheels should not exceed a rim speed of 100 feet per second.

The largest engine in England is the product of the Heirschen works of Munich. It weighs 84 tons, and moves a load of 200 tons.

It is reported that a large steel company is experimenting with a process to render steel sufficiently tenacious to supplant copper for the manufacture of rods and wire.

One square foot of heating surface in a boiler will receive and transmit 20,002 to 30,000 heat units per hour, while radiation from the same surface is limited to about 300 heat units in the same length of time.—*Stationary Engineer.*

When an agent comes around and talks about saving fifty to seventy-five per cent. of your fuel bills by some attachment or other, politely show him the door. If he talks only five to ten per cent., listen to him.—Robert Grimshaw's Hints to Power Users.

When heating water by a steam jet it is best to put an elbow and nozzle on the end of the steam pipe inside the tank so as to produce a circulation of the water while heating it, as by this means the heat is applied to better advantage and a larger portion of it is utilized.—*Stationary Engineer.*

From many experiments made on the condensation of steam in wrought iron pipes, when exposed to the open air, it is found that one pound and six ounces of steam per square foot of pipe's surface is condensed per hour when the difference in temperature between the steam and air is 200 degrees.

Bearings constructed of compressed wood pulp are the outcome of some ingenious mechanic. Combined with graphite they require no lubrication, and greatly reduce the friction. The compound can be cut or dried like metal, and is almost as hard. A dynamo is stated to have been fitted with these bearings with satisfactory results.—*Invention.*

To cleanse an engine, dissolve a pound of concentrated lye in about two gallons of water, and with a mop saturate the engine with the liquid, being careful that it does not get into the oil holes of the journals and bearings. After the lye has eaten all the grease and gum from surfaces, clean perfectly by scraping and brushing, and apply, after the iron is dry and free from grease, a thin coat of lead paint.

A number of engineers lately have asked us, says the Boston *Journal of Commerce*, concerning the tensile strength of boiler plate, what was meant by "a tensile strength of 60,000 pounds." Several evidently had the idea that that was the strength of an inch-wide strip of that particular plate. The idea is not correct. The 60,000 pounds, or the tensile strength marked, is the strength of that plate an inch thick as well as an inch wide. If the plate is one-quarter of an inch its strength will be one-quarter of 60,000= 15,000 pounds; if it is three-eights of an inch thick it will be three-eights of 60,000=22,500 pounds, and so on.

Too many engineers behind the times still use tallow as a cylinder lubricant, says an exchange, and by so doing run a great risk of eventually destroying the engine, as the several fatty acids, stearic, oleic, margaric, etc., of which tallow is composed, are almost sure to eat out the valve seat, piston rings and other parts of the cylinder. Some good mineral oil should be used, which is known to have a reputation.—*Invention.*

The interesting announcement is made in Philadelphia that a device has been invented to guard against the burning out of armatures in electric railway motors. This is done by means of a clutch, which permits the motor to start up gradually, by allowing one-fourth of the current to enter the motor at once. By this method the inventor claims that the burning out of an armature is impossible.—*Boston Journal of Commerce.*

SPARKS.

A Welsh newspaper, on the ground that the present lamps are neither suitable nor safe for the purpose to which they are put, advocates the adoption of an electric safety lamp for miners.

Bentley—"How did Larkin meet his death? When we left him last night he seemed unusually jolly." Vosburgh—"He tried to blow out the electric light in his room and burst a blood vessel."—*Brooklyn Life.*

The Terrebonne Electric Light Company has been organized at Terrebonne, Que., with a capital of $12,000. Incorporators, Hon. Lonis R. Masson, R. H. Buchanan, E. S. Mathieu, C. Gauvreau, W. Joubert, A. Piche, M. Moody, L. H. Desjardins, A. H. Masson, Matthew Moody, A. Masson, C. Chapleau, Mrs. C. Archambault.

The Great Indian Peninsula is utilising old rails as telegraph posts, and they are cheap and durable, as well as strong and inflexible. An extra piece of rail is bolted to the rail at its lower extremity, generally from 4 feet to 6 feet long for an ordinary telegraph post. This end is then buried in the ground, and the pole is ready for its fixings. The cost is about from eight to ten rupees.

One of the attractions of the new Queen's Theater in Montreal is the incandescent illumination which keeps the hall much cooler and the air much purer than they otherwise would be with gas. The foot-lights consist of three rows of lamps, red, green, and white respectively, and striking effects can be produced by turning on the red or green alone. These lights may also be turned down as gas.

Rockaby expert
On a pole top;
When the wind blows,
The cross arms will rock:
When the pole breaks,
The cross arms will fall,
And down tumbles expert, cross arms and all.
—*Electrical Enterprise.*

A method of repairing broken filaments economically has been discovered by a French engineer. A hole is made in the bulb and the broken filament taken out, excepting a small piece which is left attached to the platinum supports. The bulb is now filled with some liquid hydrocarbon, and a new filament is placed within it, in such a position that its ends just touch the remaining ends of the old filament. An electric current is now passed through the lamp; this has the effect of decomposing the hydrocarbon, liberating hydrogen gas, whilst solid carbon is deposited at the free ends of the filament in such a way that the old and the new portions are cemented together. Finally, the bulb is cleaned, exhausted of air and the hole sealed up.

The American Bell Telephone Co. of Boston has under way 50 long-distance telephone lines from Chicago to New York. Each of these lines takes two wires, making 100 lines of single wire, and as the distance from New York to Chicago is about 980 miles, the length of wire used in connecting these two points would be 98,000 miles. The size of the copper wire used in the construction of the long-distance telephone weighs 174 lbs. to the mile, making the total weight of the copper turned into wire for this one undertaking 17,052,000 lbs., or 8,526 tons, or 3,000,000 lbs. more than the total production of the Tamarack for the last year, or within about 1,800,000 lbs. of the combined output of the Quincy, Osceola and Franklin; or, omitting the Calumet, Hecla, Tamarack and Quincy, more copper than the remaining combined Lake Superior copper mines produced in 1890.

Herr E. Koeffler, in a paper read before the Vienna Electrotechnical Society, discussed the subject of the employment of dynamos and accumulators for telegraph purposes. The use of dynamos in any except large offices was uneconomical, he said. Their great first cost and the cost of maintenance and superintendence only permitted of their economical employment where, as in the United States, comparatively strong currents are used. The author admitted, however, that the substitution of dynamos for batteries at the Central Telegraph Office at Paris had effected a saving. The examples of the London and Berlin telegraph offices were cited in support of the economy of accumulators. By employing 12 ampere-hour cells on open-circuit lines, and 50 ampere-hour cells on closed-circuit lines at the Vienna Central Telegraph Office, Herr Koeffler makes out a saving of 38 per cent. over Daniell cells in the case of busy wires. He also alluded to the new departure now being made in Germany, where, at the numerous translating stations between overhead and underground lines which exist in that country, accumulators are substituted for primary batteries.

* The *Electrical World*, Feb. 28, 1891.

SAFETY VALVES—THEIR HISTORY, ANTECEDENTS, INVENTION AND CALCULATION.

By William Barnet le Van.

(Continued from January number.)

Thomas Adams, of Scotland, constructs a valve with a projecting lip A, as shown in Fig. 21. By applying steam gauges at the points shown on the sketch, he observed that they gave the indicated readings at the time the valve opened, and that then the pressure began to lower, around the valve first, and lastly in the boiler, when the valve suddenly closed.

In the navy yard trials, six safety valves were experimented on, and all of them, with the exception of the one with 5 square inches, at the pressure of 10 and 20 pounds, afforded sufficient effective areas to discharge the weight of steam generated, and by the following comparison it will be found that

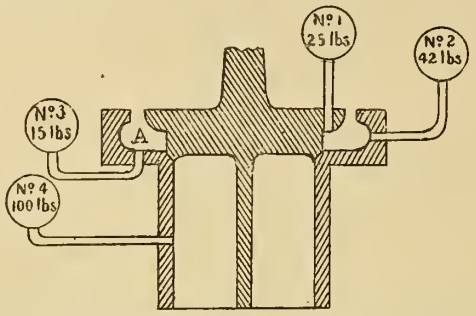


Fig. 21.—Adams' Experimental Safety Valve.

the lifts and areas of the several valves decreased from the lowest to the highest pressure in nearly an exact proportion, the difference being less than one per cent., viz.:

Decrease of lift from

5-inch,	10 to 100 lbs , 75—	of areas	76—	per cent.
10-inch,	10 to 100 lbs., 70—	"	71—	"
15-inch,	10 to 100 lbs., 82+	"	83—	"
20-inch,	10 to 80 lbs., 82+	"	83—	"
25-inch,	10 to 80 lbs., 73+	"	74—	"
30-inch,	10 to 80 lbs., 88—	"	88—	"

The committee found that when very large valves of the common form were used, their action was not satisfactory, as at high pressures the lift is scarcely noticeable. It was found that no practical results could be obtained on the experimental boiler by going above 80 pounds pressure with the larger valves. On a trial of the valve with 30 square inches area at 100 pounds pressure, it hardly rose at all from its sit, but appeared to *tilt* alternately from one side to the other, sufficient to allow all the steam to escape that the valve was capable of generating. It was also found that the lift of the valve of 30 square inch area, at a steam pressure of 80 pounds, was only 0.02 of an inch.

Fig. 22 represents the lever safety valve used in these experiments. This safety valve was carefully constructed, with knife-edges for the fulcrum and valve stem, as shown in the figure. It was found, in experimenting with

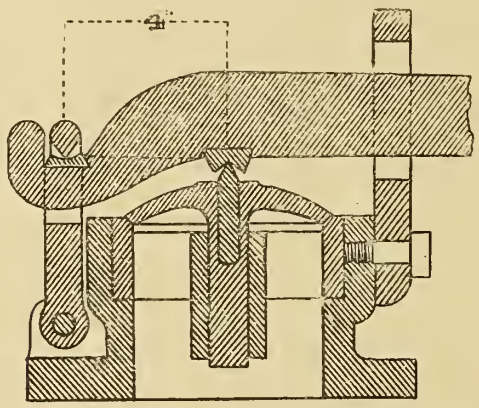


Fig. 22.—Common Lever Safety Valve Used on the Trials.

these safety valves, that the lift decreased as the steam pressure at which the valve was loaded was increased; and by taking these areas of opening, the committee arrived at the following rule for calculating the area of opening, in square inches, required to discharge a given weight of steam per hour:

Let Æ=effective area in square inches.

lbs.=pounds of water evaporated in one hour.

Then, at a steam pressure of

10	pounds per square inch,	Æ=lbs. 0.0011
20	" "	Æ=lbs. 0.0010
30	" "	Æ=lbs. 0.0009
40	" "	Æ=lbs. 0.0008
50	" "	Æ=lbs. 0.0007
60	" "	Æ=lbs. 0.0006
70	" "	Æ=lbs. 0.0005
80	" "	Æ=lbs. 0.0004
90	" "	Æ=lbs. 0.0003
100	" "	Æ=lbs. 0.0002

The committee say that in the arrangement of safety valves for any boiler, or set of boilers, that a number of safety valves are preferable to one with a large area; and they do not believe it advisable to employ a common lever safety valve, with either a bevelled or flat sit, of more than 10 square inches area (say, 3.5 inches diameter). According to their experiments, the lifts of the lever safety valve, when discharging at different pressures, two 3.5 inches diameter valves will discharge *four thousand* pounds of steam (water) in one hour, at all steam pressures from 20 to 100 pounds per square inch; and from which the committee derived the following rule for calculating the area of valve that will give the required area of opening for any particular case:

Multiply the number of pounds of water evaporated per hour by the number 0.005; the product will be the area (A) of the valve in square inches.

The Scotch committee recommend that the lift of the valve in all cases will be equal to their diameter divided by the constant number 36.

The best form for a safety valve.

A safety valve, when raised, presents a greater area to the steam pressure than when closed. Hence, it would be expected that it would open wide, due to the action of the steam pressure on this increased area. But in practice this is found not to be the case; all experiments show that the common lever safety valve lift is very small when the pressure for which it is loaded is reached. At the Washington navy yard experiments, it was found, as before stated, that two-tenths of an inch was the maximum lift on the common lever safety valve.

The committee made trial of twenty-two safety valves sent to be tested; but twelve of them passed a full trial, with two common lever safety valves furnished by the committee. From the experiments made, it was found that the patent safety valves with larger areas of openings than the common lever valves allowed the pressure to increase full as much as the latter. This was, no doubt, due to the complicated forms by which the excessive lift was accomplished, and made it more difficult for the escape of the steam, rendering it necessary to have larger openings for the same weight of steam. The results with the same valve showed great variation in some of the trials. The excessive difference was due to a proper adjustment, and when properly adjusted the best results were obtained. This was the case with both the special and common lever forms.

During these experiments, it was noted that with the common lever form of valves, when the valve opened, the pressure gradually increased to the maximum when the boiler was forced; and when the pressure began to fall, they closed at the points indicated. In the case of all the special form of valves, after the valve opened, the pressure fell below the opening point, the valve sometimes closing several times, and the pressure falling below the opening point several times during the duration of the trial, and sometimes the pressure immediately fell and the valve blew off at a pressure less than that at which it was set during the whole trial.

The following table gives the results of the different valves which passed a full trial—12 in number. Each safety valve was in turn attached to the boiler, and was loaded to blow off at 30 pounds steam pressure, and was operated for ten minutes, with a strong fire in the boiler. The steam pressure was then increased to 70 pounds per square inch, and the experiment repeated.

Loaded to open at 30 pounds.

Name of Valve.	Area of Valve in sq. inches.	Lift of Valve in inches.	Effective area of Valve in square inches.	Commenced to blow at pounds pressure per square inch.	Open wide in pounds pressure per sq. in.	Seated at pounds pres. per sq. inch.	Kind of Valve on Trial.
Borden	7	0.19	1.11	29	30	26	Combination.
Cockburn	5	0.23	1.82	29	30	27	Disk.
Crosby	5	0.12	1.257	29	30	28	Reactionary.
Clemens	5	0.2	1.171	28	30	28	Combination.
Chamberlain	5	0.25	1.58	29	30	28	Reactionary.
Hodgin	5	0.37	2.934	25	30	26	"
Lynde	5	0.14	1.11	29	30	27	Disk.
Morse	5	0.10	1.42	29	30	27	Annular.
Ormie	5	0.08	0.457	29	30	30	Reactionary.
Richardson	5	0.25	1.455	29	30	29½	"
Rochow	5	0.21	1.231	28	30	28	Piston.
Common lever.	5	0.16	0.929	29½	30	29½	Disk.
" "	10	0.18	1.469	29½	30	30	"

Loaded to open at 70 pounds.

Borden	7	0.10	0.574	60	70	67½	Combination.
Cockburn	5	0.15	1.18	69	70½	68½	Disk.
Crosby	5	0.65	0.729	69	70½	66	Reactionary.
Clemens	5	0.20	1.171	65	70	65	Combination.
Chamberlain	5	0.13	0.920	68	70	67½	Reactionary.
Hodgin	5	0.18	1.427	65	70	56	"
Lynde	5	0.07	0.555	69	70	67	Disk.
Morse	5	0.6	0.84	69	70	59½	Annular.
Orme	5	0.05	0.284	69	70	61	Reactionary.
Richardson	5	0.12	0.691	69½	70	67	"
Rochow	5	0.21	1.231	69	70	64	Piston.
Common lever.	5	0.11	0.633	69	70	68	Disk.
" "	10	0.09	0.725	69	70	68¾	"

It will be seen from the above table that the patent safety valves, with larger areas of openings than the common lever valves, allowed the pressure to increase fully as much as the latter. This was, no doubt, due to the complicated forms by which the excessive lift was accomplished, and made it more difficult for the escape of the steam, rendering it necessary to have larger openings for the same weight of steam. With the same valve, where the table shows considerable difference, the results where due to a want of

proper adjustment of the valve, which, when remedied, the best results were obtained.

With the common lever safety valves, when the valve opened, the pressure gradually increased to the maximum when the boiler was forced, and when the pressure was allowed to fall, it closed at the points indicated. With nearly all the other valves, however, after the valve opened, the pressure fell below the opening point, the valve sometimes closing several times, and the pressure falling below the opening point several times in the course of a ten minutes trial; and sometimes the pressure fell at once, and the valve blew off at a less pressure than at which it was set during the whole trial. This peculiarity is important and not a desirable feature in a safety valve, and the records of these trials fully confirm the opinion of engineers generally that the common lever safety valve, when properly made, is not excelled for the relief of the excess of steam pressure in a boiler.

It is a paradox, that a safety valve at a high steam pressure will lift less in height than at a lower pressure. This is due to the well-known fact that the greater the pressure the greater the velocity at which the steam will flow through an orifice of given size; the high velocity of the steam immediately under the valve will, by the temporary reduction of the volume there, and the consequent reduction of local pressure, cause the valve to sink lower before finding a position of equilibrium. (See tables of the experiments at the Washington navy yard.) The area of opening of the Crosby safety valve, at 30 pounds steam pressure, was 1.257 square inches, and at 70 pounds, 0.729 of a square inch, being 0.528 of a square inch difference. With the common safety valve at 30 pounds pressure, the area was 0.929 of a square inch, and at 70 pounds pressure, 0.633 of a square inch, being 0.296 of a square inch difference.

In the report on safety valve tests, made in 1875 at the United States navy yard, Washington, D. C., by a special committee of the Board of Supervising Inspectors of Steam Vessels, it is stated that an ordinary disk valve with a bevelled sit, having an area of *ten* square inches, will discharge *two thousand* pounds of steam in an hour at all pressures from 20 to 100 pounds per square inch.

The following rule for determining the size of safety valves is deduced from these experiments:

Multiply the weight of water, in pounds evaporated in one hour, by 0.005; the result is the area of the valve disk in square inches.

It is likewise recommended that the area of safety valves should not exceed 10 square inches, and that several valves be employed when a larger area is required for a boiler.

These experiments proved that the ordinary disk valve is not only the simplest in construction, but the most reliable in its action and least liable to derangement. Disk valves are made either with a conical or with a flat sit. It is claimed for the latter, that they are less liable to stick, and that they present a larger opening, with the same lift, than the former. On the other hand, it is objected that it is more difficult to keep them tight, and that the steam escapes with greater difficulty through their opening, since it has to make two abrupt changes in direction. When a wide bearing surface is given to flat-faced valves, they are apt to have a trembling, vibratory motion when they are discharging steam.

Conical valves are most usually employed, the bevel of their seat forming an angle of 45°. With a narrow face, the valve is more easily kept tight and the steam escapes with greater ease than with a wide face. Some authorities claim that a width of one-sixteenth of an inch is sufficient for the sit of a conical valve 4 inches in diameter. The valve and sit are generally made of composition metal. In some of the patent valves the bearing surfaces are formed by nickel rings let into the valve and sit.

The valve is guided either by wings attached to the disk below its sit, or by a central spindle working in a sleeve. The opinions of competent engineers differ as to which of these two devices for guiding the valve is preferable; both are liable to cause the valve to stick when they are fitted too close, in consequence of the lodgement of dirt or scale, or of unequal expansion when steam is raised quickly.

To prevent the canting of the valve in consequence of the oblique thrust thrown upon it by the lever as it lifts, the central spindle upon which the lever rests is often detached from the valve disk; the latter is hollowed out on the top, so that the point where the spindle rests upon the valve lies below the valve sit (see Fig. 23). When the spindle is rigidly attached to the valve disk, it is connected with the lever by means of a short link. The pins or bolts of the articulated joints of the lever and link are often made of composition, to lessen the liability of their becoming fast by rusting, or by getting clogged with grease and dirt. To reduce the friction as much as possible, it is best to make the lever turn on knife edges, case-hardened.

(To be Continued.)

The recent consolidation of the Western and New Brunswick Electric Companies at St. John, N. B., is expected to result in an improved and cheaper service. It is said to be the intention of the new concern to carry out in the spring extensive improvements by which additional power will be secured to operate street cars, and perform any other service which may be required.

Mr. John Galt, C. E., Toronto, has patented a steam or water heating furnace consisting of sections, with means for uniting them and providing circulation of water or steam from section to section, said sections being provided with a fire-chamber in the upper part thereof, with a stratum of water above and around the same, and flues situated beneath said chambers for conducting heated products of combustion therefrom through said section to the outlet.

SPARKS.

The Belleville Gas Co. has added a Thomson-Houston incandescent dynamo.

The Palmerston, Ont., Electric Light Co. has added a 100 light Ball dynamo.

The Welland Electric Light Co. has added to its plant a 750 light Slattery machine.

The Hutton Electric Light Co,. of Brampton, Ont., is reported to be in financial difficulties.

The Walkerton Electric Light Co. has recently added two dynamos, a new water wheel and 300 sixteen candle power lamps.

A French inventor named Picard has achieved successful results with simultaneous telephony and telegraphy along the same wire.

The paid up stock of the Vancouver Electric Railroad and Lighting Co. is to be doubled. It is the company's intention to introduce electric heating in residences.

Judge—Well, officer, who is this person, and what is she charged with?

Officer—Sure, it's the "Magnetic Girl," your honor, and she's charged with electricity.—*Puck.*

A local company, of which Mr. Hall is President, and Mr. John Murray Secretary, has recently put in operation a plant to light the streets of the town of Springhill, Nova Scotia.

An arc lighting plant has recently been installed by Mr. Alex. Shaw, at Nanaimo, B.C. The city has contracted for 40 lights, and contracts have also been made with twenty-five business firms.

The Ball Electric Light Company are making preparations for an incandescent lighting and power installation at London, Ont., and are receiving good encouragement from the business men of the city.

The electric car service lately opened between Vancouver and New Westminster, B. C., is said to have proved such a success that the Canadian Pacific Railway Company has been compelled to discontinue its trains.

An amusing episode occurred on the electric railway on Thursday. An old lady hailed a car at a crossing and told the conductor she wanted to cure her rheumatism by having an electric ride. She got on board, sat down and proceeded a block. She then stopped the car declaring she was cured and expressed her gratitude to the conductor as she left the car.—Ottawa *Free Press.*

Our contemporary, *Electrical Plant*, states that for small stations it has no doubt that the gas engine would be vastly more economical than the steam engine. Prof. Kennedy recently gave it as his opinion that the best unit for a central station should not exceed 200 H.P., for the reason that with engines of larger power it was extremely difficult to keep them fully loaded, while the efficiency of a steam engine of 2,000 H.P. is but little better than one of 200 H.P.

The total number of miles of street railways in the United States and Canada is 11,029, of which 5,442 are operated by animal power; 3,000 by electric power; 1,918 by steam power; and 660 by cable. The total number of cars on these lines are 36,732, of which 25,344 are operated by animal power, 6,332 by electric power, 3,317 by cable power, 1,044 by steam power. It is interesting to note that since November, 1890, the number of horses employed on street railway lines has fallen from 118,795 to 88,114, that is, 28,681 in one year.

The Ottawa *Patent Review* says: If our own experience in the use of the telephone is at all in accordance with that of the general public, the telephone is now practically useless at night. Induction causes a perfect roar with hardly any intermission. The metallic circuit seems to be only a partial cure for it, and at least one patent, having for its object the overcoming of the difficulty, appears to be a decided failure. It is high time that the telephone experts should devote their serious attention to this evil. Would not metallic circuits in well insulated cables laid in underground conduits be the most natural and at the same time the most successful remedy?

The theory of the nature of electricity is now this: Electricity is a wave motion of an assumed ether. When electricity does work, the form of its energy is changed. It is then no longer motion of ether, but motion of ordinary matter. Likewise, heat and light, as we receive them from the sun, are ether vibrations, and when they do work, their forms are changed in one way or another from the motion of the ether to motion of ordinary matter. When electricity is generated, the ether is distorted in such a way as to produce the electric wave, and energy is thus transformed from ordinary matter to ether, and we have electric waves or vibrations which we call the "electric current" or "electric fluid."

The consolidation of the Bell and Federal telephone companies in Montreal has resulted in the raising of the price of that useful instrument, and now instead of its being twenty-five dollars per annum it is fifty dollars. A great deal was said at the time of the lowering of the price, and indignation was shown over the fact that the people had been paying much more than was necessary. If these people would stop for one moment and think of the remarkable cheapness of the telephone at fifty dollars, they would cease to be indignant. The price makes it a little less than one dollar per week, and in a store where the telephone is in constant use this is remarkably reasonable. What office boy could be got to do the work in carrying and receiving messages for the same price? Compare the rate of our telephone service with that of any other city and it will be seen that we are favored with a good efficient service at a very moderate cost.—*Canadian Magazine of Science.*

THE RESISTANCE OF THE ARMATURE.

By Fred. H. Colvin.

There seems to be a common mistake among many electrical students, amateur and otherwise, regarding the resistance of the armature of a dynamo or motor.

At first glance the mistake is natural enough, but when the subject is carefully studied it seems incredible that such an authority as Power could announce in a note by the editor, that the resistance was half that of the entire resistance of the wire wound on the armature.

We will suppose the armature to be of the usual type with the winding in multiple arc—or parallel as it is often called.

Supposing the whole length of wire to be 2,000 feet, and taking the wire as No. 20. the resistance of the whole wire, if it was in series, would be a little over 21 ohms—call it 20 ohms for convenience of illustration.

As the winding is in multiple the 2,000 feet would be cut in two, making the resistance of *each half* of the winding equal to *10 ohms.*

This is one-half the entire resistance, and here is where too many make the error of stopping all calculations and considering the problem as finished—let it be continued and the true result will soon be apparent.

Each half of the armature winding has a resistance of 10 ohms, and when we connect them in multiple arc we present two paths for the passage of the current.

This is doubling the cross section of the conductor which, it is plain to see, will reduce the resistance offered to the passage of current by one-half, thus making the resistance of the *two* wires, *half* the resistance of the single wire for the same distance.

We now have our solution ; we cut the wire in two parts and thus halve the resistance ; then we place the wires in multiple and again halve the resistance, making it one-quarter of that of the entire winding.

Just diagram the wires on paper and the solution becomes even more apparent. Let the two lines represent the two halves of the armature windings. Connect them in series by connecting either A C or B D, and it is easily seen that the resistance would be doubled, i. e., 20 ohms. As it is in multiple, the length of wire to be traversed by the current is one-half of the whole, or 1,000 feet.

ARMATURE CONDUCTORS.

A	1,000 feet	10 ohms	B
C	1,000 feet	10 ohms	D

We have now reduced the resistance to 10 ohms for each half of the winding, and remembering that the winding is in multiple and that the current divides and flows through each half of the winding, we see that this equivalent to making a two-strand conductor which has twice the cross section that a single strand of the same size has. Now as it has twice the cross section it must be apparent to all that the resistance is reduced to one-half.

I have dwelt on this a little longer than necessary perhaps in order to have a clear understanding of this principle which is necessary in order to thoroughly study the action of the machines.—*Northwest Mechanic.*

ADAPTING THE TELEPHONE TO THE POSTAL SERVICE.

Postmaster-General Wanamaker of the United States in his annual report says : "A year from next March the telephone patent expires, and unless Congress acts promptly to authorize its adoption for communication among the people, it requires no stretch of the imagination to believe that in the next two years' one immense syndicate will unite and control all the hundreds of telephone plants of the country as the telegraph is now controlled, or the two will be united, and then for the next twenty years the most astute attorneys will be legitimately earning large salaries in indignantly opposing the so-called attacks of future Postmasters-General upon defenceless vested rights.

One-cent letter postage, 3-cent telephone messages, and 10-cent telegraph messages are all near possibilities under an enlightened and compact postal system, using the newest telegraphic inventions. The advantage of tying the rural post-office by a telephone wire requiring no operator to the railroad station must be obvious. The benefits arising from telephonic connections with the post-offices will easily suggest themselves in a hundred ways to those who want the entire people to share in common privileges. The rural population would be the greatest gainer. A telephone message from the post-office to the railroad station miles away to ascertain if expected freight had come, would save the farmer many a needless wagon trip over bad roads ; news of approaching frosts could be promptly spread over country districts and fruit-growing regions, and many a valuable crop saved.

The day's market prices for cattle and grain and wool and produce may be obtained by the farmers direct by inquiry from others than the buyer who drives up to the farm in his buggy. All these may seem homely purposes to dwellers in cities, but country life would lose some of its drawbacks by the extension of such facilities to those who bear their full share of the burdens of the government, and receive, in postal respects at least, less than their share of its benefits."

CENTRAL STATION FIRE PROTECTION.

An insurance company that makes a specialty of writing risks on electric light and power stations has recently issued, in pamphlet form, specifications for an inside hose system and water supply to protect such stations against fire. It has been a generally accepted notion that about the worst thing that could be applied to a fire in a dynamo room was water, but this notion will be quickly dispelled by the requirement of hose and apparatus by the insurance companies. A number of central stations are already thus equipped, but the practice has not been general as it promises to be in the future.

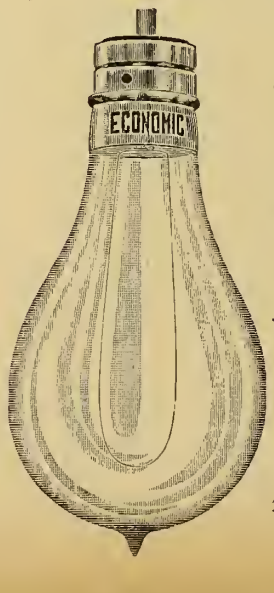
The requirement, as laid down in the pamphlet mentioned, is for a small hose system to be under constant pressure and ready for instant use at all times. It is recommended that in steam power stations, with dynamo rooms covering 5,000 feet or less in area, there be two connections in the dynamo room as remote from each other as possible, but in all cases near a door or window. An additional connection should also be put in boiler room for the first 2,500 feet of area ; and additional connections each in boiler or dynamo room for each additional 2,500 feet of area in that room. Basements and second stories should be protected in like manner. In water power stations there should be a connection for each 2,500 feet of area, but not less than two in any event.

An important recommendation is that the hose should be kept in laps on swinging racks, instead of reeled. An unimportant recommendation, and, it seems to us, an unfair one, is that endorsing a certain make of hose, when there are a number of firms making as good an article as the brand specified. Central station owners will, doubtless, cheerfully comply with the requirements for hose, but they will insist on buying it where they please.—*Whipple's Reports.*

An Edison Athletic Club has been organized at Peterborough, Ont.

The London *Electrical Engineer* relates the following instance of quick work in telephony between towns: "A public call-room has recently been opened in Tewkesbury by the Western Counties and South Wales Telephone Company. The *Tewkesbury Record* representative was, at the occasion of the opening, put into communication with Cheltenham and a report which we have before us was transmitted for press. It was spoken from Tewkesbury to Cheltenham, in the limit of time allowed to users of the telephone for communication between towns, and is, we think, one of the smartest pieces of telephone work which has ever taken place. There are 700 words in the report, and to communicate that number of words in three minutes indicates a great deal of smartness on the part of the sender and receiver."

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SPARKS.

A factory lately started at Trenton, N. J., proposes to use seamless rubber as an insulating material.

The town of Annapolis, Nova Scotia, is to be lighted by an Edison plant owned by Messrs. Fraser & O'Dell.

Now that electrical men have become so ambitious in their schemes for the transmission of energy over long distances by means of electricity, the *India Rubber World* thinks the manufacturers of insulated conductors will have to bestir themselves in order to meet the demand for insulating materials capable of withstanding very high pressures.

For a cash consideration of $5,000 the Reliance Electric Light Company transfers to the Stratford Gas Company their contract with the city, and two miles of wire, poles, and lamps—the remaining fifteen or sixteen miles of wire, poles, lamps, and dynamos to remain the property of the Reliance Company and be removed from the city. Gas Company assumes the city contract on the terms specified therein, relieves the Reliance Company of their contract for power with the North American Mill Building Company, and withdraws the legal proceedings entered to set aside the contract.

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According to the New York *Electrical Review*, Chief Barrett, of the electrical department of the World's Fair, is confronted by what appears a unique predicament. He states that owing to the many and rapid improvements being made in electrical machines, most manufacturers are afraid to prepare an exhibit until the last minute. By the time the fair opens, two years hence, the fixtures they now have in hand may be, according to Chief Barrett, the most antiquated of "chestnuts."

In an interesting experiment in long-distance telephoning made in Australia during October last, when the postmasters-general of Victoria and South Australia, with their principal executive officers, succeeded in conversing by wire between Melbourne and Adelaide, a distance of 500 miles, the instruments of Hunnings and Berthon are said to have been more effective than those of Berliner and Blake. Animated conversation was carried on for over an hour,—during which the chimes of the post-office clock in Melbourne were distinctly heard in Adelaide, the chimes in the latter post-office as distinctly answering back. The governments of the two colonies have just completed the suspension of a No. 12 copper wire, over which these experiments were made.—*Practical Electricity.*



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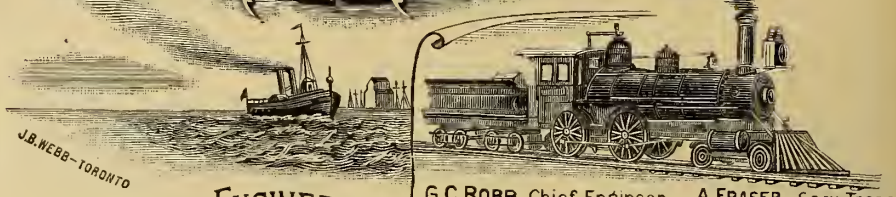
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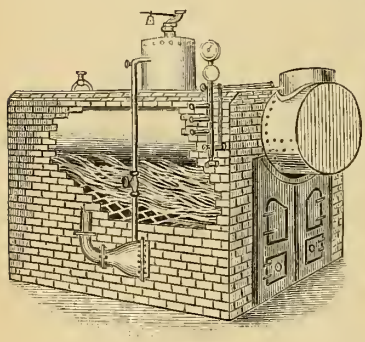
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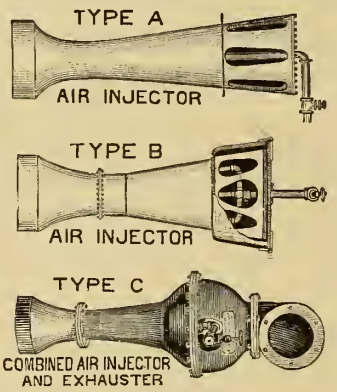
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TORONTO, CAN., Nov. 4th, 1891.

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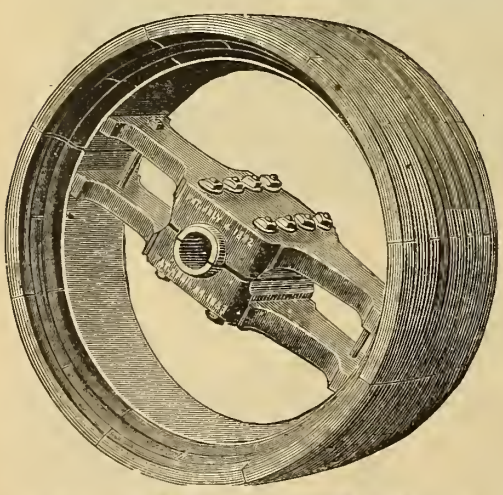
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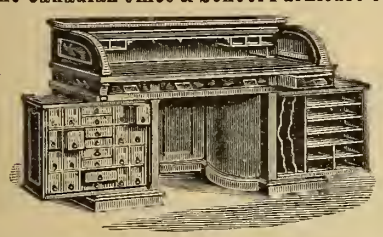
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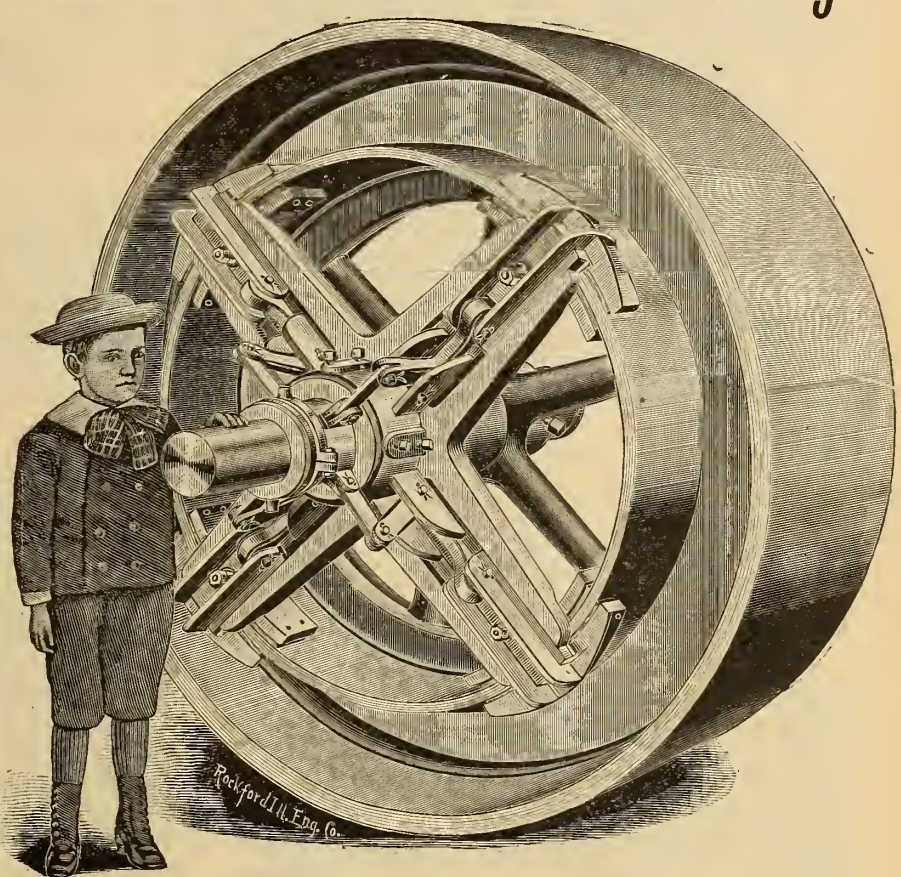
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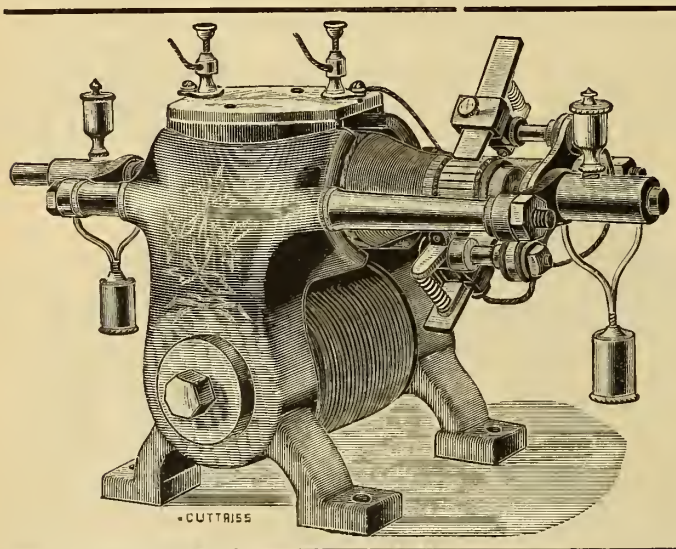
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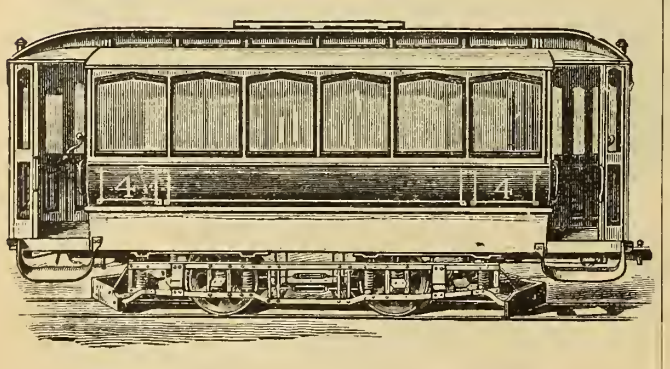
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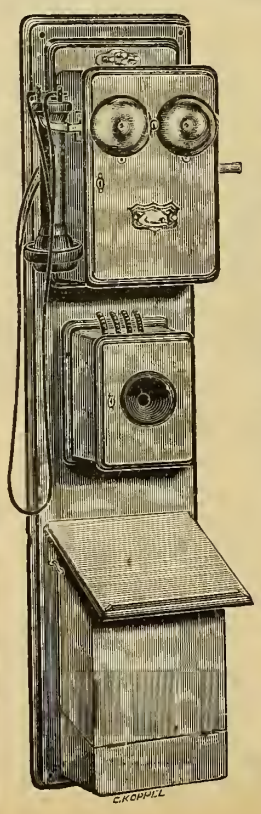
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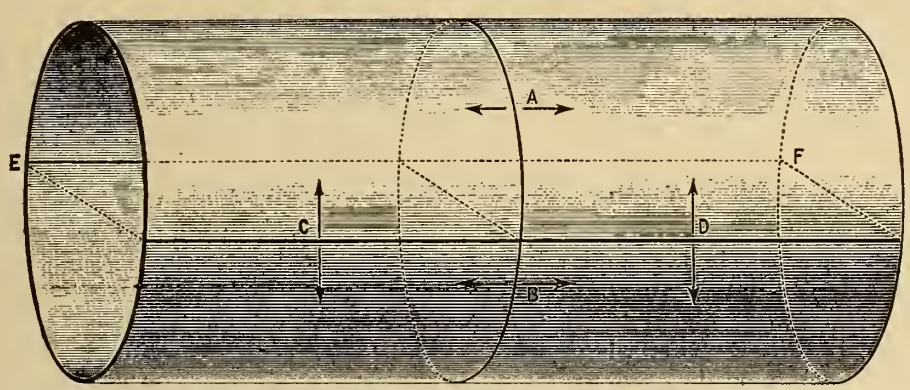
STEAM ENGINEERING JOURNAL.

VOL. II. TORONTO AND MONTREAL, CANADA, MARCH, 1892. NO. 3.

LONGITUDINAL AND GIRTH JOINTS IN BOILERS.

ALL writers upon the subject of steam boiler design devote considerable space to the discussion of the longitudinal joints, but it has appeared to some of our readers that the girth joints have not received sufficient attention. For example, in boilers that are to withstand high pressures, the longitudinal joints are now usually made by abutting the plates, and securing one or two overlapping straps to the plates by means of two rows of double or triple rivetting ; while the girth joints on the same boiler are ordinary, single-rivetted lap joints. It is the purpose of the present article to make it plain that this construction is correct, and if the single-rivetted girth joint is properly designed, it is still considerably stronger than the double butt-strap, triple-rivetted longitudinal joint.

The cut represents a hollow cylinder of steel, an ideal boiler shell, without heads or joints. It is 66 inches in diameter, and 14 feet long. The thickness of the metal is ⅜ of an inch, and its tensile strength, let us say, is 55,000 pounds per square inch of section. If this shell is burst by steam or water pressure, the fracture can run longitudinally, along the lines *E F D C*, or around the boiler, along the line *B A*.



LONGITUDINAL VS. GIRTH JOINTS IN BOILERS.

Let us first find the bursting pressure, assuming that the fracture takes place longitudinally. At the moment of rupture, the strain on the metal must be just equal to its tensile strength ; that is, to 55,000 pounds per square inch. The area of plate to be broken, along the line *C D*, is $168 \times ⅜ = 63$ square inches, 168 being the length of the boiler in inches, and ⅜ being the thickness. The section along *E F* has the same area, so that the total area to be broken across is $2 \times 63 = 126$ square inches ; and since the strain on each square inch is 55,000 pounds at the moment of rupture, the total strain on the section of rupture will be $126 \times 55{,}000 = 6{,}930{,}000$ pounds.

The total steam pressure tending to force the two halves of the boiler apart is equal to the pressure per square inch multiplied by the area of the cross-section of the boiler, which area, in this case, is 168 (length of boiler) × 66 (diameter of boiler) = 11,088 square inches. Those who are not familiar with this sort of calculation sometimes find it hard to understand why the surface of the shell is not used, instead of the area of cross-section. The answer is, that the pressure on the half *E A D*, for example, does not all act in the same direction, owing to the curvature of the shell. The pressure on parts that are close to the line *C D* acts almost horizontally, while on the parts lying along the top of the boiler it acts vertically. It would be easy to take these varying directions into account, but the same result can be reached without any figures, and in a very simple way. Suppose, for example, that the lower half of the boiler in the cut should be taken away, and that a flat plate should be bolted to the upper half in its place. If steam is now admitted, experience tells us that the boiler will not move either up or down ; and it follows from this that the pressure against the curved half of the structure is precisely equivalent, so far as forcing the halves of the boiler apart is concerned, to that against the flat plate bolted to it. Hence, as was stated in the first part of this paragraph, the total pressure tending to force the two halves of the boiler apart is equal to the pressure per square inch, multiplied by the area of cross-section of the boiler (11,088 square inches).

The pressure that would burst a shell like that shown in the cut is of such a magnitude, therefore, that if it is multiplied by 11,088 square inches (the area on which it acts) the product will be 6,930,000 pounds. Hence the bursting pressure is $6{,}930{,}000 \div 11{,}088 = 625$ pounds per square inch. This is not the bursting pressure of a *boiler* of this size, but simply of a steel shell of the given dimensions ; for we have not yet taken account of the joints that occur in boilers.

Let us now see what pressure would be required to force the boilers apart endwise, tearing it along the line *A B*. The only thing that can produce a strain acting lengthwise along the boiler, is the pressure on the head, which is equal to the steam pressure per square inch, multiplied by the area of the head in the present case being $66 \times 66 \times .7854 = 3{,}421$ sq. inches.

To withstand the strain so produced we have a ring of metal at *A B*, which is 207.3 inches in circumference ($66 \times 3.1416 = 207.3$), and ⅜ of an inch thick. The area of this ring is $207.3 \times ⅜ = 77.74$ square inches ; and when the shell is about to break, the strain upon the section *A B* will be $55{,}000 = 77.74 = 4{,}275{,}700$ pounds. When the boiler parts, therefore, the steam pressure must be such that, by acting on an area of 3,421 square inches, it produces a resulting strain of 4,275,700 pounds. Hence the bursting pressure per square inch is $4{,}275{,}700 \div 3{,}421 = 1{,}250$ pounds.

The results that we have thus far reached are, that it would take a steam pressure of 625 pounds per square inch to rupture a shell of the given dimensions longitudinally, and that it would take precisely twice this pressure, or 1,250 pounds per square inch, to rupture it circumferentially.

If the shell were made up of plates, rivetted together, we should have to modify the foregoing calculation somewhat, so as to take account of the diminished strength due to the existence of the joints. Let us suppose there is a single-rivetted girth joint whose dimensions are as follows : Diameter of rivets, ¾ inch ; diameter of rivet holes, 13-16 inch ; pitch of rivets, 1¾ inches ; tensile strength of plates, 59,000 pounds. It will be found that this joint has 53 per cent. of the strength of the solid plate ; so that the pressure per square inch that would rupture such a shell circumferentially, so as to blow the two ends apart, would be 53 per cent. of 1,250 pounds. $1{,}250 \times 53 = 662.5$. It would therefore take 662½ pounds to the square inch to pull this girth joint apart. But from our previous calculation it appeared that 625 pounds would tear the *solid plate* apart

lengthwise; so that it appears that the solid plate would tear longitudinally before a properly proportioned single-rivetted girth joint would fail. This is ample justification for the use of single-rivetted girth joints even when the longitudinal joints are butted and strapped and triple rivetted.

Let us suppose that the boiler has triple rivetted butt-strap joints, such as were described in the *Locomotive* for July, 1891, the dimensions of the joints being as follows: Strength of plate = 55,000 pounds per square inch; thickness of plate = ¾ inch; diameter of rivet holes = 13-16; pitch of inner row of rivets = 3¼ inches; pitch of outer rows = 6½ inches. In the issue of the *Locomotive* cited above the efficiency of this joint is shown to be 87.5 per cent. The pressure that would rupture the shell longitudinally being 625 pounds, the pressure that would rupture a similar shell with a longitudinal joint proportioned as above would be 87.5 per cent. of 625 pounds, which is 547 pounds; and the safe working pressure, allowing the usual factor of safety of 5, would be 547 ÷ 5 = 109 pounds per square inch.

To illustrate the fact that a single-rivetted girth joint is stronger than any form of longitudinal joint, we have taken a particular case and computed the strength in both directions. A general proof of the same fact might be given, applicable to all diameters of boilers, all thicknesses of metal, and all styles of joints; but the proof would be algebraical, and for this reason we have not thought it necessary to include it. Those of our readers who understand algebra will have no difficulty in finding the general proof for themselves, for it is based upon precisely the same considerations as the numerical example given above.

CANADIAN ELECTRICAL ASSOCIATION.

A MEETING of the Executive Committee of the Canadian Electrical Association was held at 11 o'clock a. m. on Feb. 10th, at the Palmer House Hotel, Toronto, Mr. J. J. Wright in the chair, C. H. Mortimer acting as secretary. The following members were present: T. H. Wadland, D. Thomson, K. J. Dunstan, A. B. Smith, E. D. Edmonson, John Yule, S. J. Parker and H. O. Fisk.

A number of applications for membership were considered, and the following new members elected: R. M. Gardiner, Electric Light and Power Company, Hamilton; J. A. Kammerer, agent Royal Electric Co., Toronto; H. Brown, St. Thomas; J. Langton, manager Edison Electrical Works, Peterboro'; E. Franklin Clements, president Gas Light Co., Yarmouth, Nova Scotia; C. W. Hagar, D. Starr, F. Thomson, Royal Electric Co., Montreal, and Messrs. Keegan and Milne, Montreal; C. Berkeley Powell and J. E. Brown, Standard Electric Co., Ottawa.

On motion of K. J. Dunstan, seconded by D. Thomson, the secretary was instructed to write to persons who attended the meeting for organization of the Canadian Electrical Association but who have not sent in their applications for membership, forward to them application form and request to know whether it is their intention to become members of the Association.

It was suggested that members should prepare papers to be read at the first annual convention in June as follows: Mr. S. J. Parker, "Does Electric Lighting Pay?"; Mr. J. J. Wright, "Power"; Mr. A. B. Smith, "Safe Wiring"; Mr. K. J. Dunstan, "Construction Work"; Mr. D. Thomson, "Central Stations"; Mr. H. O. Fisk, "Carbons."

On motion of Mr. Edmonson, Messrs. Thomson and Wadland were appointed a sub-committee to arrange for place of meeting in connection with the annual convention in June, also for the accommodationof exhibits, and for motive power in connection with the same.

On motion by Mr. Parker, the President, Vice-President and Secretary were appointed a committee to interview the railway authorities regarding special rates for those attending the convention.

On motion by Mr. Smith, the Toronto members of the Executive were appointed a committee to prepare a circular for distribution, setting forth the objects of the Association, to secure the preparation of papers to be read at the annual convention, to formulate a programme for the convention, and to report at the next meeting of the Executive Committee.

On motion by Mr. Thomson, seconded by Mr. Dunstan, it was decided that the next meeting of the Executive would be held on the second Wednesday in March.

THE STORAGE BATTERY FOR STREET RAILWAYS.

AN INTERESTING CORRESPONDENCE ON THE SUBJECT.

IN view of the fact that the Roberts Storage Battery Co., of Toronto, are asking the City Council to refuse permission to the Street Railway Company to adopt the overhead trolley electric system, on the ground of the superiority of their storage battery system for the purpose, we have thought it well to reproduce some correspondence which the publisher of the ELECTRICAL NEWS had with this company a year ago, arising out of an article in this journal on the adaptability of the storage battery for street railway work. It will be seen that the company, while professedly willing to submit their battery to a practical test, when urged to do so found means to evade the trial. Such being the case, the public will know what value should be attached to their present efforts to balk the carrying out of a great public improvement. The articles and correspondence referred to are as follows:—

"If ever there was a crying need for an underground conduit for electric railways that need is felt to-day. Improvement upon improvement has been made in the cars, the track, and especially in the motor and electrical outfit. Their success is a tangible and solid reality. The electric method of propulsion is practicable beyond a doubt, but the full and complete fruition of its success will not be realized until the unsightly and cumbrous overhead construction can be done away with. It would seem to the tyro a simple matter to lay a trench to contain the wires with a slot on top to enable the car to make a wiring contact with it at any point in its progress, but the fact remains that the more it is tried the more frequently and emphatically are its difficulties demonstrated. Wet, or even dampness—the arch enemy of the electrician—are fatal in the case of the open conductor such as must be employed to admit of contact with the moving motor. A perfectly insulated conductor in a closed conduit and carrying an alternating current intended to work the motor by induction has been proposed—something similar in principle to the telegraph employed on moving trains—but it is evidently a case of "the wish being the father of the thought" and we should not feel disposed to squander much wealth on the patent of the scheme. Another proposition to overcome the difficulties of a conduit and to reduce the leakage to a minimum is to employ a sectional conductor, a short length only being automatically placed in communication with the main insulated conductor while the car is upon it, and disconnected as the car leaves it and enters upon the next one ahead. The chief objection to this plan would seem to be its complexity and liability to derangement at most critical times. The storage battery is at present a forlorn hope, yet it would be idle to say it will never be made commercially available. It must, however, be radically improved before it can be. Though at present it may be a somewhat forlorn one, yet we *do* hope that the storage battery will be the coming solution of the problem. The advantage of having the car carry its motive power along entirely independent of connection with anything else and able to run on any track at present constructed would be a consummation devoutly to be wished. Its success would place the electric car upon the tracks of every street railroad in the Dominion, and our larger cities which now hesitate on account of the objectionable overhead construction, would rejoice in the fulfilment of their desires. The next best method not open to so much objection would be the conduit, providing it can be successfully accomplished. Some of the foremost of the construction companies are working at the problem with all the skill at their command. Let us hope that every success may crown the efforts of some enterprising inventor, and then the electric railroad on our busy streets would become a thing of beauty and a joy forever."

14 KING STREET WEST,
TORONTO, Jan. 21st, 1891.

ROBERTS STORAGE BATTERY CO.,
Adelaide Street West, City.

DEAR SIRS:—I understand from a gentleman who called on you in the interests of this paper a few days ago, that you complain of some of the statements made in an article on the commercial utility of the storage battery.

I desire to say that the article in question was written without bias of any kind, and if the statements therein are in any way incorrect I shall be pleased to afford you the space necessary to correct any mis-statements which may possibly have been made.

Any matter for publication intended for next issue should reach us not later than the 26th inst.

Respectfully yours,
C. H. MORTIMER.

TORONTO, Jan. 23rd, 1891.

Editor ELECTRICAL NEWS.

MY attention having been called to an article in your January number, and believing that the writer would readily avail himself of the opportunity of being set right in reference to the all

important and interesting question of the possible use of the storage battery system, for solving the question of rapid and comfortable transit, and eliminating all ideas of intentional misconception and allowing the error of judgment manifested in the article to be excusable, I nevertheless desire to set the matter before your already numerous readers in its proper aspect.

I notice the article in question refers to the storage battery as "a forlorn hope," and yet hopes against hope that the problem will be solved by an economically successful storage battery. Why, only on Thursday last in the Toronto Courts of Arbitration, Mr. Rice, the eminent City Engineer of Cleveland, on the witness stand said, in answer to counsel, that the storage battery question had been solved for street car work, and further answered in reply to questions put to him as to where the question of the commercial value of the accumulator had been solved : "Right here in your own city you have the best storage battery system on this continent, and the best for street cars or any other work I have ever seen." In reply to further questions, he said he referred to the Roberts storage battery system, of Toronto. Truly a prophet is never without honor save in his own country.

I have four distinct engagements in four different cities of the States to put my system in operation. With scarcely any effort, but simply on representations of experts, a company was formed in the States a few days ago, with a capital of $1,500,000.

Prof. Pike, a name known and relied upon all over the Dominion, after examining every known system on the continent, returned and gave an order for the School of Practical Science.

Statements regarding new storage batteries are practically worthless. In a masterly article in the *Electrical World*, the statement was made that the man who could point to a positive plate that had stood six months rough and careless work had solved the problem. Last week we forwarded to C. O. Mailloux, of New York, a positive plate that had been in constant service and subjected to continual travel for very nearly two years. Mr. Mailloux in reply expressed an opinion that established a record, and one we had need to be proud of. We are now engaged upon a plant for car work and forming a company for that distinct purpose ; that is, of utilizing the battery for car purposes.

Now, in what are the distinctive features necessary to insure a perfect battery for car work? Why exactly the features required in every purpose to which a storage battery is applied : 1st, Freedom from buckling ; 2nd, Disintegration of the paste ; 3rd, Capability of standing heavy charging and discharging. These are or have been the common difficulties to be met with in the solution of this problem. We have overcome every one of them. We have not been deterred by the "forlorn hope" ideas of anybody—no true plodder in the pathway of scientific research was ever deterred by that idea In proof of that we give a three years guarantee.

What we have done can or may be improved upon by others, but this much is certain, that before many weeks pass a storage battery system will be in operation in or near enough to this city that will for ever settle the problem. We have quietly replaced and are replacing all the leading makes, and such is our confidence in our system that we have applied for patents in every country in the world where it is possible to obtain them.

The question has been solved in England. The Central Tramway Company, of Birmingham, are putting an extensive system into operation there ; the North Metropolitan Company are also using storage batteries. They will have to be used in all crowded cities, and certainly nowhere, in my opinion, would the practical solution of the question be hailed more gladly than in Toronto and Montreal. Hamilton made an offer of track, car and motor for a test on their line, which offer we respectfully refused, as we did not care to be trammelled by an agreement that rendered necessary the possible subversion of our ideas.

We have the battery, experienced engineers, and the advent of our company will at once dispel "forlorn hopes," by the recognition of the end and object of the work of years.

A few days ago, at the invitation of the T. H. overhead system, Ald. Saunders, the mayor and a number of city gentlemen enjoyed the hospitality of the President, and after expressing their approval of everything, yet said that the storage battery would be the only permissible electric system allowed in the city.

Yours truly,

WM. ROBERTS.

"We publish elsewhere an epistle trom the exponents of a storage battery who apparently take exception to our remarks on storage batteries in general We should have been better satisfied if, instead of claiming superiority for their battery, they had shown or made an attempt to show, in what respect it is superior to others in experimental use to-day. Wherein does the construction differ? Does the material used differ from others, and if so, what is the advantage of the difference? If the battery is covered by patent, there should be no hesitation in courting the fullest publicity on these points. The refusal of an offer of car, track, and motor to demonstrate its efficiency, is to say the least of it, curious. When it is well known, and has been so expressed by us that a successful storage battery is the El-Dorado of street railway men, that it is the crying need of the electrical would to-day, we should have thought that the proprietors of this bonanza would have jumped at the chance to show their goods without cost to themselves. This journal has no antagonism to any individual or industry. We aim to chronicle the progress of electrical science as it actually presents itself, and while of course we court the advertising patronage of our electrical friends, our highest aim is to make the ELECTRICAL NEWS of value to all engaged in electrical and engineering pursuits. To do this we intend to express our opinions of men and things without fear or favor, to chronicle events and discoveries as they actually present themselves, and to condemn the sharks who make use of a little smattering of electrical knowledge to make a raid upon the pocket books of the unwary in the name of science. By adopting a straightforward course and issuing a journal that can be depended upon, we shall increase our circulation to an extent that will make it necessary for any progressive concern to make use of its columms to reach the public. If we express opinions that to our readers may seem to be open to criticism, we shall be most happy to hear from them, and if we make a statement that appears not to be borne out by facts, and such is demonstrated to us, we will make full, public and complete recantation. We are proud to say, however, that during our publication of the ELECTRICAL MECHANICAL AND MILLING NEWS from its inception till it gave place to the present paper, we have had no occasion for anything of the sort, but on the contrary, "coming events" have so plainly "cast their shadows before," that in every case changes and developments which are so rapidly taking place in this progressive science have been accurately and completely foreshadowed by us. We make no exception in this matter of the storage battery. We have expressed our opinions of it, knowing what we talk about. We have said that no imitations of those "not dead" perhaps, but simply "gone before," will ever solve the problem, and that success must be looked for on new lines. We are, however, more anxious that our increasing *clientele* should have the fullest information on what is doing and actual facts connected therewith, than we are for our own glorification, therefore we make this offer to the storage battery people in question : Produce fifty of your cells, place them in charge of an expert appointed by us and one by you for a thorough and exhaustive test, and the results shall be made public without fear or favor. You have the floor."

TORONTO, 7th Feb., 1891.

C. H. MORTIMER,
Editor ELECTRICAL NEWS, Toronto.

DEAR SIR,—Referring to your editorial relating to the letter signed by our Mr. Roberts, in your issue of Feb., we beg to say that the letter was written by your own request, and further it was submitted to you for approval, and it seems to us that had it not, in your opinion, gone into full enough detail, you should have said so at the time. As far as the construction of the plate is concerned, there has been certainly no hesitancy on our part in explaining in detail the peculiar construction of our battery. Our pamphlet (one of which was given you) gives both by cuts and printed matter, the fullest information on this point. Regarding the refusal of car, etc., which you say appears "to say the least curious," the explanation given you by our Mr. Macfarlane, and which we think was satisfactory to you, might have been earlier in your possession had you so desired it. Re your next remarks as to "electrical sharks," we accept, for ourselves your explanation that it in no way referred to us, but the general tone of your editorial, we think, was such that a reader would naturally infer that you were referring to us, and we must request you, in your next issue, to make the matter right.

Regarding your offer of testing cells, we will be more than pleased to have you test our battery at any time, and will place cells in our factory at your disposal for as exhaustive tests as you wish to make. Be good enough to let us know what day will be suitable to you. Yours truly,

THE ROBERTS STORAGE BATTERY AND ELECTRIC CONSTRUCTION CO.
By J. H. Macfarlane.

TORONTO, Feb. 9th, 1891.

ROBERTS STORAGE BATTERY
AND ELECTRIC CONSTRUCTION CO., City.

DEAR SIRS :—Replying to your letter of the 7th inst. received this morning, in which you express your willingness to submit your battery to a test as proposed in our editorial in February number of ELECTRICAL NEWS, I am pleased to observe your apparent readiness to have demonstrated by disinterested parties the merits of your invention.

Mr. J. J. Wright, manager of the Toronto Electric Light Co., to whom I spoke on the subject immediately after the conversation had with you a few days ago, has kindly consented to act as judge on my behalf in connection with such a test of your battery as we proposed. It will be necessary for you to appoint your expert to act with Mr. Wright in the matter.

The test should include 50 cells, and should take place outside your premises.

Mr. Wright offers to provide all the facilities necessary for a

[*Continued on page 46.*]

MONTREAL ENGINEERS' VISIT TO McGILL UNIVERSITY.

MONTREAL, Feb. 6th, 1892.

Editor ELECTRICAL NEWS.

SIR,—Through the courtesy of Prof. Bovey and the faculty of McGill University the Stationary Engineers'-Association No. 1 of Montreal recently availed themselves of the opportunity of visiting the Department of Applied Science in connection with that institution.

They were received by Prof. Bovey and conducted through the different departments, where they saw what was of interest to them. This remark will apply particularly to the testing room, where the Professor gave a practical illustration of the method of getting at the breaking and torsional strains of different kinds of timber.

I feel sure that the engineers received much benefit from the visit. The members were in charge of a committee composed of Bros. Ryan, Smith and Robertson. On retiring from the building, Bro. Ryan thanked the Professor on behalf of the visitors for his kindness and the interest he had manifested on behalf of the Association. We hope it will not be our last visit to McGill University.

Yours truly,

"PUCK."

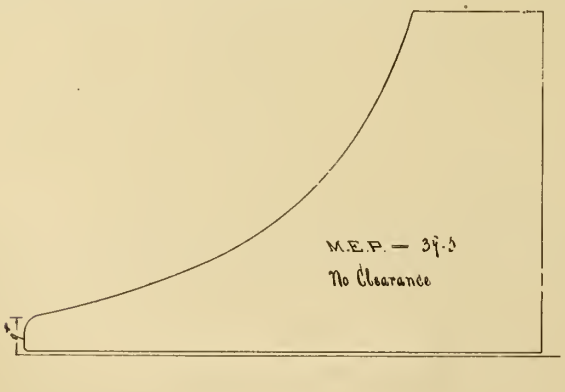
A WORD OF ADVICE TO ENGINEERS.

MONTREAL, Feb. 20, 1892.

Editor ELECTRICAL NEWS.

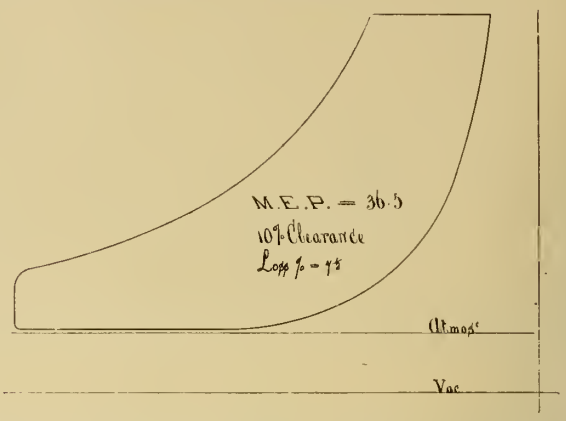
DEAR SIR,—The qualities that go to make an engineer are, first, an understanding of his position and what is required of him, particularly in taking charge of a new plant. I do not mean a new engine and set of boilers with everything in first-class order, and including all the latest improvements, but one that has been run for some time, and which may have been in charge of a careless man, one who thinks anything is good enough for an engineer. Such a state of things should be of the past, not of the present. The engineer may find under such circumstances that his engine is pounding, that his draft is poor and he can't get satisfaction out of his boiler. Yet his best course will not be to get mad and swear at the man he has succeeded, nor go to the office and complain that he wants a new engine and boiler—in fact, a new steam plant altogether. Rather let him look the matter squarely in the face, make up his mind that he has something in the line of a difficult job on his hands and get to work with a will.

After having made a careful inspection of the boilers, he should go and stand beside the engine, get acquainted with it, study all its faults, be sure he knows what ails it—where it pounds and where its lost motion is—and that he can improve it a good deal before starting to work with wrench and hammer. After all lost motion has been taken out of it, and it is found that every time it passes its centres it gives a dull heavy thud, this is where his practical knowledge should come to his assistance. He should call in the help of the indicator, but supposing he does not understand the working of an indicator, let him lay his difficulty before the Association of Stationary Engineers, when he may depend that some brother will set him right. The writer has done so, with what effect can be seen. After the indicator was put on we got a card like this :



Now this was all a mystery to me. The brother said my engine valves were late, and that if I was willing he would adjust them for me. I replied "go ahead." He said that my engine was pounding for the want of more cushioning. After a little fixing on the valve rods we set it in operation again ; the result is that I am satisfied, and my engine is now running very smoothly.

A word to any engineer who thinks he knows it all : I would



advise you to join some engineers' association. I think you will find some one who knows a little as well as yourself. In union of numbers there is strength and knowledge, you will become a competent man in your calling, with the capacity to fill positions of importance and emolument.

Yours truly,

"PUCK."

THE TILSONBURG ELECTRIC STATION.

February 12th, 1892.

Editor CANADIAN ELECTRICAL NEWS.

DEAR SIR,—Some few days ago I was in the busy little town of Tilsonburg, and having occasion to remain there over night, concluded to visit the electric light station. I found it to be a brick building 30x50", just over the G. T. R. bridge on Broadway. I opened the front door and walked in, feeling a little timid, for a man must be very careful how he conducts himself in *some* of the small stations, as the men in charge seem to have an undue idea of their importance in their own particular sphere, and seem to deny the right to others to express an opinion. However this kind of men is not very numerous. As soon as I got inside the station I saw a man who readily granted my request to be allowed to look over the plant. The gentleman was Mr. F. J. Barkey, who is the owner of the plant, and who also fills the position of engineer and electrician, assisted by his brother, Mr. W. E. Barkey.

The plant consists of one 45-light 1,500 c. p. 6 amp. Reliance arc machine and one 300-light 17 c. p. 110 volt, incandescent machine, the latter built by the Dominion Electric Co., of Fergus, Ont. The power is supplied by a 12x30" Harris Corliss engine, built by Messrs. J. Inglis & Sons, of Toronto, which runs 80 rev. pr. minute, the average load being about 45 h. p. The steam is supplied by a 54"x12" 58 3" tubes, steel boiler, which was also built by Messrs. Inglis & Sons, and which carries a pressure of 80 lbs. per sq. inch.

The average run in winter is seven hours per night, and the amount of fuel consumed averages 1,200 of soft coal per run of nine hours. The coal costs $3.85 per ton laid down at the boiler room door.

Everything around this plant is kept in good order ; there is a place for everything and everything is in its place.

Mr. Barkey speaks very highly of the performance of the Reliance arc system, also of the Harris Corliss Engine.

The writer spent a very pleasant time with Mr. Barkey, and takes this opportunity of thanking him for the courtesy and kindness extended to him.

Yours truly,

TRAMP.

The Belgian Government has informed the Belgian Telephone Companies of its intention to resume from January 1, 1893, the working of all the telephone lines in Belgium.

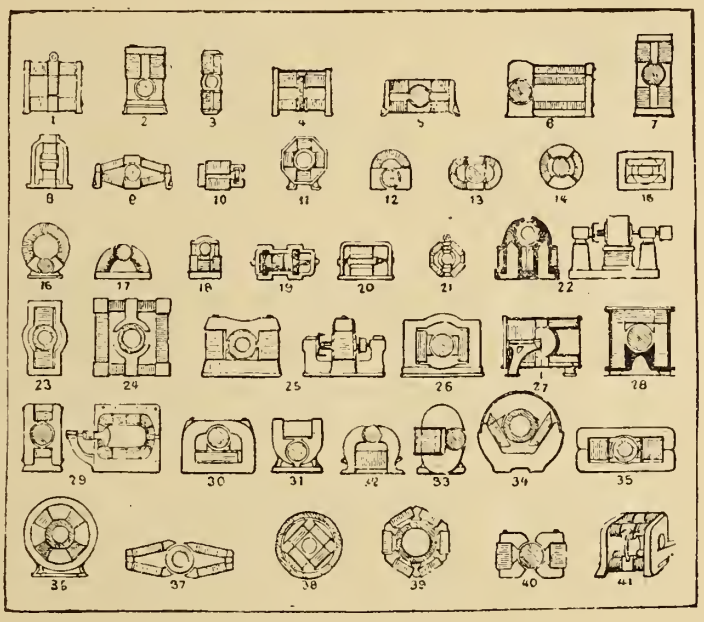
A report from Winnipeg states that there is a disposition to upset the action of the Council of last year in granting the franchise for an electric street railway to Messrs. Ross & McKenzie.

The Globe Furniture Company, of Walkerville, Ont., have just installed an electric plant for lighting their factory. It was manufactured by the Jenny Motor Co., of Indianapolis, Ind. It operates 75 Edison lamps, a current of 110 volts being employed for the purpose. The results are very satisfactory.

DYNAMO MACHINES.

If there are any apparatus that have particularly exercised the imagination of inventors, they are assuredly lamps, commutators and dynamo machines. These latter, especially, have become very numerous in recent years. It is easy, however, to establish a classification between the different models. Every dynamo comprises two principal parts, viz., the armature and the inductor. The various kinds of continuous current armatures may all be referred to three well known types of winding—the Gramme, the Siemens and the Edison. Besides these there are still other types that we must consider, and, in particular, the Desroziers winding. We shall not dwell upon the details nor upon the advantages and disadvantages of these various armatures as they have already been presented to our readers.

As for the inductors, the same is not the case. It is but a few years ago that the labors of electricians indicated the conditions that these parts of the dynamo must satisfy. Among such conditions we may mention one in particular. It is necessary to reduce as much as possible the magnetic resistance of the current, or the resistance offered to the flux of force through the iron of the electros, and the air between the iron of the electros and the iron of the ring. The flux of force, as we know, is the product of the intensity of the magnetic field created by the surface embraced. Moreover, it must not be forgotten that a wire surrounding a piece of iron, and being itself traversed by a current, magnetizes such iron and creates in the interior a magnetic field of a certain intensity. If we take the product of such intensity by the surface of the piece of iron, we obtain the flux of force, the consideration of which is a most important matter in the construction of dynamos. These few remarks suffice to show that, in a good dynamo, the flux of force should have a maxium value. It is well, then, for a given number of windings of wire, to be careful as to the nature of the metal of the inductors, to employ iron of very great magnetic permeability, and to reduce as much as possible the resistance of the air necessarily interposed between the inductor poles and the armature. This latter condition imposes the obligation of placing the inductors as near as possible to the armature, leaving just the space necessary for the motion of the armature, and afterward of making the latter embrace the widest surface possible.



Dynamo Machines

The second part of a dynamo machine, the inductor, gives rise, as may be seen, to more numerous inventions than the armature. In fact, there has been no want of models. One of our most learned electricians has conceived the happy and original idea of bringing together, in one plate, the various types of inductors of continuous current machines, which we reproduce in the accompanying engraving.

No. 1 represents the well known Gramme machine, No. 2 the Edison-Hopkinson, and No. 3 shows us the arrangement of the Siemens dynamo, with drum armature and horizontal inductors. This machine bears also the name of Hefner Alteneck, the engineer-in-chief of the Siemens establishment. In No. 4 we find the Schuckert type, with disk armature, and in No. 5 the form of the Weston machines, with drum armature, of the Burgin ring machines, and of the Crompton, Patterson and Cooper machines. No. 6 shows the large Edison machine of 1880, which was adopted by all the American central stations and by the Milan station. No. 7 represents a third type of the Edison dynamo of four or five bobbins. To this type is referred the English machine Phœnix. No. 8 gives the aspect of one of the first types of the Gramme machine. Messrs. Burgin & Crompton devised a dynamo, which is represented in No. 9, but which is now abandoned. In this we find the first principles of the Meritens and Jackson machines. Fig. 10 gives a diagram of the Kummer & Company machine, which is similar to the Jones dynamo and Gramme motor. In No. 11 is found represented one of the first models of the Gramme machine with several poles—a model which has since been constructed with more or less modification by the Oerlikon and Allgemeine Gesellschaft Companies, of Berlin. In all these machines we find a large external polygonal ring, to which, according to the radii, are adapted iron arms which, in the center, leave between them an annular space, in which the bobbin revolves. No. 22 shows a motor devised by Sylvanus Thompson. No. 13 is a modification of the inductors of the dynamo No. 9, proposed by Mr. Kapp for the reduction of the magnetic resistance of the circuit. No. 14 is a section of the well known Griscom motor. No. 15 is a new form of motor for electric railways, constructed by the Thomson-Houston Company. In No. 16 is figured a section of the Eddy & Mather American machine. No. 17 shows a Ferguson dynamo. No. 18 shows one of the commonest forms of the Goolden & Trotter dynamos. The dynamo of the Telephone Company of Zurich is represented in No. 19, the Guzzi-Ravizza and Ironsides in No. 20, and the Tyne dynamo, of Scott & Moutain, in No. 21. No. 22 gives a section and profile of a superior type of Gramme dynamo, devised by Kapp, and since imitated by a number of manufacturers. No. 23 represents the Hochhausen dynamo. No. 24 the Elwell, Parker & Crompton dynamos, and No. 25 the Manchester type, due to Hopkinson. It is to this latter type that belong the Brown of Oerlikon, Mather & Platt, Sautter & Lemonnier, Tighe, Joel, Clark-Muirhead, Blakey, Emmot & Immisch and Sprague machines. Nos. 26, 27, 28, 29, 30 and 31 show, respectively, the Lahmeyer, Thomson-Houston, Wenstrom, Eickemeyer, Continental and Mordey & Jones machines. No. 32 represents a form common to several American motors, notably to the Patten and United States and Jenney motors. Silvanus Thompson devised the dynamo shown in No. 34. No. 35 gives the Form of Kennedy's ironclad dynamo machine. Finally, the Alioth Helvetia, Elwell, Siemens (with interior poles), Thury, Kester, Brush or Schuckert-Mordey or Victoria dynamo machines are represented in Nos. 36, 37, 38, 39, 40 and 41. This enumeration comprises but a few of the principal types of continuous current machines, now no longer new. Doubtless, among all these dynamos, there are several that are superior to the rest, but still, the same qualities are sometimes reached by various means and different forms, and it is often difficult to fix one's choice between several models. The question of cost alone intervenes. The short history that precedes shows the path that the dynamo machine has traveled since its invention, and it proves that the mind of inventors has not remained inactive.—*La Nature.*

PUBLICATIONS.

We have received from the secretary a copy of the annual report of the Toronto Board of Trade. It is a volume of 100 pages, containing full statistics of the city's commerce, a list of the members, description of the new Board of Trade building, annual reports of the president, secretary and treasurer, etc.

The *Electrical Review*, published at 13 Park Row, New York, celebrates its tenth anniversary by issuing a very handsome Decennial Number dated February 20th, 1892. This issue contains a large number of very handsome illustrations and numerous special articles of more than ordinary merit. A history of electrical progress for the past ten years is an important feature. This Decennial Number of the *Electrical Review* is alike interesting to the layman and electrician, and presents in a graphic and interesting manner the landmarks of electricity for the past ten years with an outline of what the future may have in store for us in this field.

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SUBSCRIPTIONS.

The ELECTRICAL NEWS will be mailed to subscribers in the Dominion, or the United States, post free, for $1.00 per annum, 50 cents for six months. The price of subscription may be remitted by currency, in registered letter, or by postal order payable to C. H. Mortimer. Please do not send cheques on local banks unless 25 cents is added for cost of discount. Money sent in unregistered letters must be at senders' risk. Subscriptions from foreign countries embraced in the General Postal Union, $1.50 per annum. Subscriptions are payable in advance. The paper will be discontinued at expiration of term paid for if so stipulated by the subscriber, but where no such understanding exists, will be continued until instructions to discontinue are received and all arrearages paid.

Subscribers may have the mailing address changed as often as desired. *When ordering change, always give the old as well as the new address.*

The Publisher should be notified of the failure of subscribers to receive their papers promptly and regularly.

EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

RECENT tests have demonstrated the superiority of porcelain as compared with glass insulators. The inferiority of the glass usually used in the manufacture of insulators is given as the cause of their inefficiency.

THE laws of the State of New York provide for the exemption of manufactories from taxation. The courts have been asked to decide whether electric light stations are entitled to rank as manufactories. The decision is that electricity is a manufactured product, and an electric station a manufactory.

THE important announcement is made that an understanding has been arrived at between the Thomson-Houston Co. and the Edison General Electric Co. which will result in the amalgamation at an early date of the interests of these great concerns. This amalgamation will no doubt be beneficial to all the manufacturing and supply houses, inasmuch as its object seems to be to maintain rather than cut prices.

THE French section of the stationary engineers of Montreal have organized a society, the officers of which are as follows :— President, J. Guimond ; first vice-president, C. Tourgeon ; second vice-president, J. Fecteau ; secretary W. Gendron ; assistant-secretary, A. Latour ; treasurer, J. Martineau. Committee : J. Bissonette (chairman), H. Bernier, T. Langlois, A. Ducap, W. Leclaire, R. Drouin and J. Gauthier. Guardian, C. Morin ; conductor, J. Frenette. The membership already numbers upwards of one hundred. The promoters of this movement are to be congratulated upon the success which has attended their efforts.

WE are reminded of the terrible calamity which happened in Quebec on the 12th of February last year, when a boiler explosion killed twenty persons at the Riverside Worsted Factory, by reports from Quebec that Marie Therien has entered an action for $10,000 damages for the killing of her husband by the explosion at the worsted factory last year, against the directors, Messrs. Andrew Paton, R. W. Hencker, R. Brodie, John Turnbull and the Hon. M. A. Cochrane. Another plaintiff, named Simeon Hamel, is claiming $2,000 from them for permanent injuries sustained on the same occasion. As the law now stands these parties may recover the damages claimed, and, if so, the loss of the Company by the explosion will be serious. Other boiler owners should take every precaution to avoid such complications as have arisen in this case.

THE opinion which prevailed to a large extent some time ago that there was an abundance of profit to be derived from the business of supplying electric light, and that consequently it was to the interest of municipal corporations to purchase and operate their own plant, is undoubtedly being discredited. That this is the case is shown by the fact that several of the corporations who purchased plant, and engaged in the manufacture of electric light, are now endeavoring to sell out to private concerns, while others are passing through an experience of difficulty with the management of electric apparatus, which should serve as a warning to their neighbors. It is shown in an article elsewhere that in the hands of those who have invested private capital in the business, the results have in many instanees been unprofitable, and it is safe to say that as a rule private management is likely to be more economical than that exercised by the officials of municipal corporations.

THE formal opening of the newly equipped laboratary in connection with the School of Practical Science took place on the evening of February 24th. In response to invitations from the faculty the building was thronged with citizens—in fact so great was the attendance that it was to a large extent impossible to examine the many interesting appliances connected with the institution. Although the equipment of the School is not complete, yet with the addition of the new laboratory it is in a position to give to young men a satisfactory technical training in civil, mechanical and electrical engineering and architecture. It is a subject for congratulation that we have now a native institution capable of imparting instruction to our young men in these important branches, and from the spirit of earnestnes which is being manifested by the Minister of Education and the faculty, the School of Science seems destined soon to rank among the best equipped and most efficient technological colleges on this continent.

WE publish in another column a latter from a subscriber at Petrolia, calling attention to the fact that many of the readers of the NEWS lack a rudimentary knowledge of electricity, including familiarity with the technical terms employed in the science, and that consequently much of the information furnished by the ELECTRICAL NEWS is unintelligible to this class of readers. We have not been unaware of the fact to which our attention is called, and have endeavored from time to time to publish such information as we deemed would be of advantage to primary students of electricity. We have also to some extent published definitions of the technical terms employed. It would appear, however that we have not gone far enough in this direction to suit the requirements of some of our subscribers, and therefore we are very glad that our attention has been directed to the subject. It is our desire that subscribers should advise us in this way, of their needs, and thus place us in a position to supply them. In the present issue is published an article headed, "What is a Dynamo?" which has been written with the object of furnishing the information asked for in our correspondent's letter. We shall endeavor to supplement this article by others equally easy of comprehension, and which we trust will serve to explain to those who are inexperienced, the principles on which the various types of electric apparatus are constructed as well as the methods of their operation. Meanwhile, if any of our subscribers have suggestions to make, we shall be pleased if they will present them.

MUCH has been heard of the danger attendant upon the system of stringing electric wires overhead, and reiterated demands have been made that all wires be placed underground. It is questionable, however, whether the carrying out of this demand would not tend to enhance rather than diminish the danger. An example of the peril which is likely to attend the underground system occurred in Toronto a few days ago. Illuminating gas from the street mains found its way in sufficient quantity into one of the man-holes in the public streets through which passes a telephone cable, to require but the faintest induction spark from the covering of the cable, or a spark of atmospheric electricity to cause an explosion. The spark appears to have been forthcoming, for suddenly the heavy iron man-hole covering which had been firmly bolted down, was torn from its seat and carried into the air. A horse which was being

driven past the spot at the moment fell into the man-hole, and before it could be extricated there occurred a second explosion, burning the animal severely. The driver of the horse and another person who happened to be near the man-hole when the explosion occurred escaped with slight injuries. It is a well-known fact that about 10 per cent. of the total supply of illuminating gas which goes to the street mains leaks out at the joints and saturates the earth. This gas must find its way into the man-holes, and when the right admixture of gas and air is reached, the material is ready for an explosion. There is always danger with underground wires that the inductive current set up in the lead covering of the cable may become sufficiently strong to generate a spark which would be the means of igniting the combustible materials. Had the explosion to which we have referred taken place in the man-hole at the intersection of King and Yonge streets, where the traffic is always great during business hours, there would in all probability have been many persons killed. The daily press which has so often held up to view the horrors of the overhead system, should now have something to say on the other side of the question.

It is learned that the Convention of the National Electric Light Association of the United States which took place in Buffalo last week was perhaps the most successful, from a business point of view, ever held. The social frivolity which was so marked a feature of former conventions was to a considerable extent frowned down, and thereby much valuable time was afforded for the consideration of matters of serious moment. No action was taken on the motion to change the name to the "International" Association. The development of the Canadian Electrical Association was no doubt taken to mean that the representatives of Canadian electrical industries consider that their interests will be better served by a purely Canadian organization. It was decided that the conventions of the National Association shall hereafter be held not oftener than once a year unless it should be thought advisable to hold a meeting next year in connection with the Worlds' Fair at Chicago.

Previous to the organization of the Canadian Electrical Association, Mr. S. J. Parker, President of the Owen Sound Electric Light Co., issued circulars to the owners of electric plants in Ontario, requesting information which would serve to indicate the financial condition of the industry. Quite a number of replies were received, and the result is of a somewhat startling character. Out of twenty-five companies who responded to the enquiries, only fourteen were paying dividends; out of thirteen plants operated by steam power, only five were paying dividends; and out of a total invested capital of nearly $1,000,000, $560,000 was paying no return to the owners. Those companies which were paying dividends were obtaining from their customers not less than twenty-five cents per lamp for such lamps as were kept burning until midnight, and forty cents for all night lamps. In view of this showing, there is great need for steps to be taken to place the business of electric lighting on a more profitable basis. This can only be done by means of united action on the part of those interested, and we know of no better way of dealing with the subject than through the medium of the recently organized Canadian Electrical Association. We understand that prices in Canada are very much lower than in the United States. The present condition of affairs cannot last for any length of time, and the sooner action is taken to bring about an improvement the better for those whose capital has been invested in the business. There is no reason why capital invested in electric lighting should be non-profitable any more than when employed in other legitimate enterprises. No individual or company should be expected to employ their money for the public benefit without receiving a fair return in the way of profit. We understand that Mr. Parker, who is in possession of much valuable data, has consented to prepare a paper on the subject for the forthcoming convention of the Canadian Electrical Association to be held in the City of Hamilton, in June next. This paper should provoke a full discussion of this most important question, and result in some action being taken to bring about an improvement.

As will be seen by the report in another column of the meeting of the Executive Committee, the Canadian Electrical Association is a live and growing institution. The membership already numbers about 35, and is representative of the leading electrical industries of the country. During the last month there have been received a considerable number of applications for membership, some of which have received the approval of the Executive Committee, while several others which came to hand at a later date are waiting to be passed upon by the Committee at its meeting on the 9th inst. Some of these applications have come from the far north-west, others from the maritime provinces, which may be regarded as a gratifying proof of widely-diffused interest in the movement. At the last meeting of the Executive, sub-committees were appointed to bring the Association and its objects before the notice of persons interested in electrical matters, and to push forward the arrangements for the first annual convention which will take place in Hamilton in June. It is already certain that a number of very valuable papers will be forthcoming at this convention, and it is the determination of those who have the arrangements in hand that the occasion shall be one of so much interest that al will be amply repaid for their attendance. While the main object of the convention will be to afford instruction and business profit to those engaged in electrical enterprises, our electrical friends in Hamilton may be depended on to provide ways and means to render the visit a pleasant one from the social point of view. To those who have not as yet become members of the Association, we wish to say, it will pay you to do so. If you are desirous of improving your knowledge of electricity, or of any form of its application, the Association will assist you; if you have your capital invested in the business and want to know how the greatest remuneration may be secured from it, the Association will help you; if you wish to see hostile legislation defeated and cut-throat competition done away with, you should connect yourself with the Association and work shoulder to shoulder with those who are desirous of promoting electrical interests in these and all other directions.

We would strongly urge upon central station managers who are supplying incandescent lighting, the advisability of using the meter system of supply only, for then the customer pays for just what he consumes and no more; the company supplying the current will then find that they can add fully twenty per cent. additional lights on their dynamos. Under the contract system it is found that the customer will burn all the lights whether he actually requires them for his business or not whereas with the meter system of supply he will know that when he turns on a light he commences to pay for it, the consequence of which is that there are no more used than are actually required, and if it is found that the occasional lighting of one or two lights in an unfrequented part of the store is necessary to display his wares, care is taken to see that they are turned off when they are no longer required. Then again the revenue in most cases will be found to increase rather than diminish when meters are used, for while there may be actually no increase in the amount of money that is paid for the lights, there is bound to be a perceptible difference in the coal pile. To those companies or individuals who are running dynamos until midnight only, there can be no question but that it would be of decided benefit too, for then the customer who allows his lights to burn (under the contract system) until the machine stops, "just as an advertisement," even though his store has been closed two or three hours earlier, will invariably turn his lights out when he closes his shop up for the night, which means so much in pocket for the company supplying them. There should be no hesitancy therefore in adopting meters, which with a monthly rental of 25 cents, will pay interest on the amount expended for them, and leave quite a nice margin for wear and tear. We well know that there is a tendency with some managers to doubt the practicability of electric meters, but there cannot be an atom of doubt in that direction, if they will but look up the records where they are extensively used both in Canada and the United States. It is but a foolish prejudice at best that will sway one's opinion to the extent of not using them, and a prejudice that would soon vanish into thin air did they but give them a trial. In this connection they would perhaps come to regard them as a veritable boon when they shall find that as a result of their use they are deriving a revenue from one hundred or more lights out of every five hundred that their dynamos are capable of producing. With such meters as the Schallenberger, Slattery and Thomson Recording Watt-Meter, many hundred of which are in daily use, it seems crude, and we may say, almost primitive, to see lighting companies installing incandescent lights at so much a month or year. It is a well known fact that in nearly all the large European cities the current for both arc and incandescent lighting is supplied by meters, with little or no dissatisfaction among the customers, and with every satisfaction to those supplying them.

THE ELECTRIC TRANSMISSION OF POWER.

By Gisbert Kapp.

(Continued from February Number.)

What we generally desire to get in practice is a constant speed of the motor, whatever may be the mechanical power taken out of it at any moment. This condition is the same as that required from a good steam engine or other well-governed prime mover. The construction of the motor to comply with this requirement depends, of course, on the condition of supply. We can imagine a large variety of cases; but, from a practical point of view, I need only consider two, namely, supply at constant pressure such as we get, or ought to get, from mains connected with a central electric light station, and supply of current at constant or variable pressure from a generator erected specially for the purpose, the regulation of current and pressure being automatic. The latter case is that more particularly met with in long distance transmission of large powers, the former is a case referring rather to the distribution of small parcels of power over short distances from a central station. I will take this first.

We have, then, these supply conditions—pressure at the terminals of the motor constant, current variable according to the

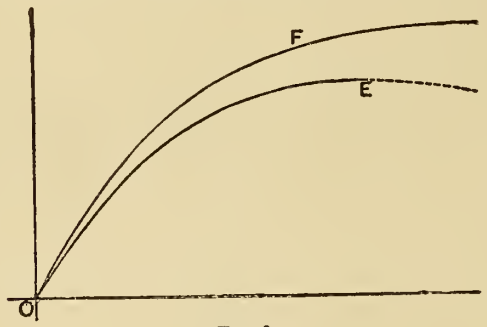


Fig. 4.

call for power. Let (in the diagram Fig. 4) the curve F represent the characteristic of magnetisation an electromotor, that is, a curve obtained by plotting ampere-turns of exciting power on the horizontal and total field strength (denoted in the formulæ by F or Z) on the vertical. If the motor is series-wound, you see that the larger the current the stronger will be its field, and by referring to the E.M.F. formula you will find that if the speed is to remain constant the counter E.M.F. must increase in the same ratio as the field strength increases. But the counter E.M.F. must, under all circumstances, be smaller than the supply E.M.F., by just the amount required to overcome resistance of the circuit through the motor, and this difference is, of course, proportional to the current. To satisfy the supply condition the counter E.M.F. of the motor ought to slightly decrease as the load, and with it the current, increases, then the speed will keep constant. But this is exactly the opposite of what the motor requires. Say the machine is running at a certain speed, and giving out a certain amount of mechanical power. Now increase the load. The immediate consequence will be that the speed is slightly decreased, the counter E.M.F. is slightly decreased, and the current is increased. This will immediately strengthen the field, and thus raise the counter E. M. F. again ; this will check the current, produce a further drop in speed, and so the reaction will go on until a new stable condition of working is reached at a larger current and lower speed. If we take the load off, the same reaction takes place, only in the opposite sense, and the speed may become dangerously high. What I have here described happens, of course, only if the machine is worked on the rising part of the E.M.F. characteristic E, the part which we would naturally select for economical working. If we over-excite the field magnets, that is, if we employ a great deal more field wire than necessary, then we can work the machine on the drooping part of the characteristic shown by a dotted line in the diagram, and obtain approximately constant speed between certain limits, but the machine will still be liable to race as soon as we throw the load off completely. We thus find that a series-wound motor is certainly not suitable for our purpose.

Let us now inquire whether we shall be any better off with a shunt-wound motor. The field excitation in such a machine does not depend on the current flowing through the armature as in a series machine, but it is simply the result of the terminal pressure ; in other words, whatever current may be required by the armature for giving power, can be and is, in fact, supplied by the source of current, without in any way affecting the field excitation. If the terminal pressure varies, the excitation and the field strength must also vary, but a variation in the working current will not directly influence the field strength. It will, however, indirectly influence it by reason of a subsidiary effect technically termed "armature reaction," and this I shall touch upon shortly. For the present we neglect it, and assume that the curve F correctly represents the field strength as a function of the terminal pressure. In machines having wrought-iron magnets the first part of this curve is almost a straight line, and in this region the field strength is consequently very nearly in direct proportion to the terminal E. M.F. To work the motor at this part of its curve all we have to do is to supply it with current at a pressure sensibly lower than that for which it is designed. In good machines the resistance of the armature is very low, so that only a few per cent. of the voltage supplied is lost in resistance, even when the maximum current flows through the armature. If, therefore, we work the motor considerably under its power, the armature loss will be almost negligible, that is to say, the counter E.M.F. will be very nearly equal to the supply E.M.F. Now, if you look at the formula for E.M.F., you find that on the left you have a value very nearly equal to the supply E.M.F., and on the right you have a constant multiplied with the product—field strength and speed. But the field strength under our special conditions of working is proportional to the supply E.M.F. on both sides of the equation, it cancels out, and you find that the speed, multiplied by a constant, is equal to unity. This, of course, holds good for any supply E. M.F. within the straight part of the curve ; and we find, therefore, that the speed has a definite value which is independent of the supply E.M.F. We have here arrived at a very remarkable result. It is this, that if you work a shunt-motor underloaded and at a lower pressure than it is designed for, you may vary this pressure within certain limits without either altering the speed or the power given out.

As, however, the motor must be large in proportion to its work, the practical use of this remarkable property of shunt-motors is limited. What users of these machines want to do is not to get little power out of them, but to get as much power as possible, and, in many cases, more than was intended by the designer. Let us, then, see how we stand in the matter of speed and power regulation when we work the machine throughout the whole range of output for which it is designed. First, as to speed. Let us assume that the machine is working at a certain speed giving off a definite amount of power, and sup-

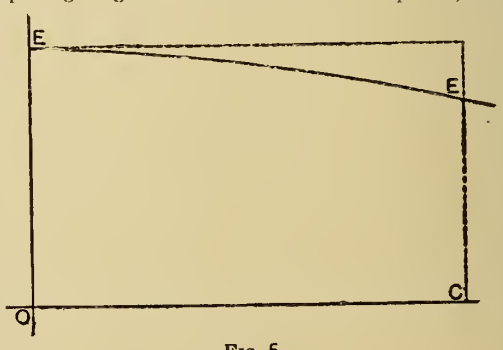


Fig. 5.

pose we wish to increase the speed. How shall we do it? The E.M.F. formula tells us. You see that field strength and speed occur on the same side of the equation. This means that the one can only be increased at the expense of the other. If we want the machine to run faster we must weaken its field, if we want it to run slower we must strengthen it. The variation of field strength is most conveniently brought about by a variable resistance in the magnet circuit. I have such a resistance in the shunt circuit of the machine before you, and can show you, by an experiment, this method of regulating the speed.

In this experiment we have altered both the speed and power, because, by running faster, we have obtained more current from the second machine and a brighter light in the lamp. Let us now see whether it is possible to keep the speed constant, and yet vary the power. Bearing in mind that the dynamo is a reversible machine, and drawing a parallel be-

tween a shunt-dynamo and a shunt-motor, we conclude that there should be no difficulty in doing this. The fact that a shunt-motor is an almost self-regulating machine has been first pointed out by Mr. Mordey in an article which appeared in January, 1886, in the *Philosophical Magazine*. Mr. Morley's reasoning was somewhat as follows :—We know that a shunt-dynamo will, if driven at a constant speed, give an almost constant terminal pressure, no matter how the current may vary. Consequently, a shunt-motor, if supplied with current at constant pressure, will run at an almost constant speed, no matter how the load may vary. On testing his theoretical deduction by actual experiment, Mr. Mordey was able to completely verify it. In one set of experiments the supply current was kept at 140 volts, and the load on the motor was varied from 1·8 to 16.3 H.P., yet the speed only varied by 3 per cent. ; and a similar result was obtained with the same machine at a supply pressure of 100 volts. Mr. Mordey stated in his Paper that the magnetic distortion of the field was *nil*, or, as we might also term it, that the armature reaction was negligible. It is, however, easy to see that, even if the armature reaction is sensible, we can yet obtain very fair regulation, provided we take care to have in the armature circuit such a resistance that the voltage loss due to the resistance is about equal to that due to armature reaction.

To explain this I must first say a few words about armature reaction, a phenomenon which may, perhaps, not be familiar to all of you. The current flowing through the armature transforms it into an electro-magnet, which, to a certain extent, opposes the flow of magnetic lines emanating from the field magnets. This is the case both in dynamos and motors, though not quite to the same extent. The larger the current the larger is the opposition which the armature offers to the field magnets ; and it is the field strength which remains, after making allowance for this opposing magnetic force, which is productive of electromotive force. To calculate correctly the counter E.M.F. of a shunt-motor, we must, therefore, not assume the field strength in our E.M.F. equation to be constant, as I have done hitherto ; but we must assume that it decreases slightly as the armature current increases. Graphically, this is represented in

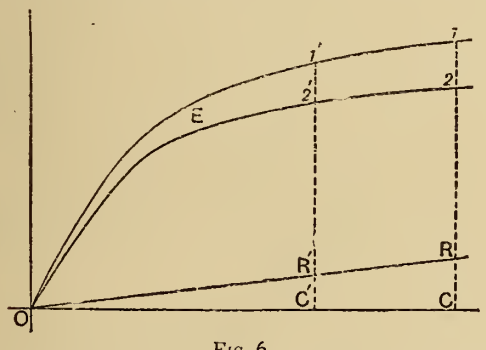


Fig. 6.

Fig. 5, where the current flowing through the armature is measured on the horizontal O C, and the field strength is represented by the inclined full line above. If there were no armature reaction, the field strength would be given by the dotted horizontal line. If the speed is to remain constant, the counter E. M.F. must be proportional to the field strength ; and, by suitably altering the scale (with which we measure the ordinates in the diagram), we can take the top line to represent counter E. M.F. I have acccordingly marked it E E.

The vertical distance, O E, represents now the supply E.M. F. ; and when the motor is running light, this is, of course, equal to the counter E.M.F. Now, let a load be thrown on, causing a considerable increase of current. The counter E.M. F. need now not be quite so large as before, since part of the supply E.M.F. has been already absorbed by the resistance of the armature circuit, and the counter E.M.F. need only balance the remainder. We find, thus, that the supply condition of constant voltage requires the counter E.M.F. to become lower, as the power demanded from the motor increases. At the same time, the working condition of constant speed can only be attained by a lowering of the counter E.M.F. as the current increases ; and it is, therefore, perfectly obvious that, if the lowering of the counter E.M.F., as determined by either condition, is the same, we must have constant speed at variable power—that is, a self-regulating motor. Generally, the line E E in the diagram representing counter E.M.F. is not quite straight, but slightly curved, presenting the concave side to the axis of abscissæ ; whilst the line representing resistance loss through armature is, of course, quite straight. If we so design the machine as to get exactly the same speed when running quite light and fully loaded, the speed will be slightly less at half-load, but the difference can only be very small. I am able to show you this property of the shunt-motor to be almost perfectly self-regulating by means of the apparatus here before you.

Thus you see that the shunt-door motor is an excellent machine for keeping the speed constant when worked on a constant-pressure circuit. The only drawback to its employment is, that the resistance must be inserted into the armature circuit at starting ; but this may be done automatically, by placing the resistance permanently in circuit, and causing it to be short circuited by means of a centrifugal regulator fixed to the armature shaft, and so arranged that when the speed has attained a certain value the balls fly out and close a switch. Such an automatic device is also of value in case the motor should be overloaded. If this should happen the speed will drop, and the resistance will be automatically re-inserted, keeping the current within safe limits. By these means a customer of an electric light company is prevented from taking from the mains more current than he has contracted for.

Before leaving the subject of speed regulation on constant pressure circuits, I must briefly allude to a system in use on electric tramways. Motors for tram-cars are not required to run at a constant speed, but they are required to have a wide range of torque. At starting or when running uphill, the speed may be low, but the static effort must be great. These motors are, therefore, generally series-wound, and provision is made by means of a compound switch for inserting a larger or smaller number of field magnet coils, so as to vary the field strength according to requirements. The arrangement of the motors under the floor of the car is shown on the diagrams on the wall, which represent respectively the cars of Mr. Reckenzaun, the Electrical Engineering Company, and the General Electric Power and Traction Company, but time will not permit of my going into the details of the various designs.

When current is supplied to the motor not from a general system of mains, but from a special generator, serving no other purpose, the regulation of speed and power can be effected equally well by series, compound, or shunt-machines. As regards the latter, I need not go into details, as this case is really included in the case of supply at constant pressure, which I have already fully treated. After what I have said about this case, you will also readily see that compound wound motors with the main coils demagnetising are equivalent to shunt-motors with large armature reaction, and that, in fact, a shunt-motor with very small armature reaction, such, for instance, as a multipolar machine, may be made self-regulating by the addition of demagnetising main coils on the field magnets. I shall later on give you details of a large transmission plant carried out on these lines, and need, therefore, not go further into the subject now. There remains, then, only the plain series motor to be considered.

In this case both the generating and the receiving dynamo are series-wound, and it is easy to see that by suitably designing these machines we can bring it about that the motor will run at a constant speed under varying loads if the generator is kept running at a constant speed at all times. Let the two curves in Fig 6 represent E.M.F. characteristics of the two machines, the upper curve referring to the generator and the lower to the motor. These curves give the useful E.M.F. after deducting armature reaction, and refer, of course, to constant speed in each case. The current flowing through the circuit is that which we obtain by dividing the difference between the ordinates of the two curves by the total resistance. The resistance is, of course, a constant, and the curve representing current and difference of E.M.F. is, therefore, a straight line, O R in the diagram. The vertical length, C R, gives the voltage loss with a current, O C, due to resistance, and this must be equal to the voltage difference, 1, 2, between the curves. This determines, therefore, the speed of the motor for that particular current. Suppose the lower curve is the E.M.F. characteristic

for that particular speed. Now, let us throw some of the load off, then the current will assume a smaller value, say O C′ The voltage loss is now C′ R′, and the voltage difference 1′ 2′. If the E.M.F. characteristic fits this new working condition, then 1′ 2′ must be equal to C′ R′, and the speed will remain the same as before. We thus find that if we so design the machines that the difference between their E.M.F. characteristics at any working point is equal to the voltage loss by resistance, we obtain a perfectly self-regulating system of power transmission. Most of the transmissions now at work have been designed by taking advantage of this very valuable quality of series machines, but I must state at once that, in actual practice, the case is not quite so simple as I have here represented it. One of the difficulties met with is that we cannot always get the two characteristics to fit each other exactly over the whole range of output ; another difficulty arises from there being generally a slight difference between the ascending and descending characteristics ; but the most serious obstacle to quick and perfect regulation is the self-induction of the field magnets, especially if the machines are large. The self-induction prevents the rapid response of one machine to the other which is required to make the regulation absolutely perfect. A sudden change of load cannot be followed immediately by a corresponding change in the power supplied to the motor, as time is required by the magnets to settle down into the new working condition ; and during the transitory period, which may last many seconds, there is a surging of power to and fro which creates fluctuation of speed. To mitigate this evil, Herr Dobrovolsky, of the Berlin Electric Company, has devised a plan by which a kind of electrical damper is applied to the generator in the shape of a non-inductive high resistance placed across the terminals of the magnet coils as a shunt, and left there permanently. Any abnormal wave of E.M.F. which might otherwise disturb the working of the motor or endanger the insulation of either machine spends itself in heating this resistance, and the disturbance quickly subsides.

THE LINE.

I pass now to the consideration of the line, a subject of great importance, especially in long distance transmission, since in these cases the cost of the line forms a very large item in the total cost of plant. You are all familiar with Sir William Thomson's law for greatest economy in conductors. Briefly, the reasoning on which this law has been developed is as follows :—The annual cost of power delivered is made up of two items. First, the cost of the power only, and secondly, the interest on the capital outlay. The cost of power includes that amount which is wasted in heating the conductor. If I therefore wish to work with the greatest economy, the sum of annual interest on the capital outlay and cost of power wasted must be a minimum ; and this condition is attained when the two are equal. Profs. Ayrton and Perry were the first to question the practical applicability of this law. In a Paper read by them before the Institution of Electrical Engineers, in March, 1888, they showed that, under certain conditions, better economy can be obtained by departing from, instead of following, Sir William Thomson's law. I do not propose to give you quotations from their paper, which is highly mathematical, but I will endeavour to put the subject before you in a different way, requiring only very little mathematical treatment.

First of all, let us see, in a general way, what Sir William Thomson's law really means. It supposes that the annual electrical horse-power has a definite value at any place reached by the conductor. This is generally assumed for the distributing system as carried out from central stations. Whether a customer lives 100 yards or 500 yards from a central station, the company charges him the same for the current. But the assumption is not, strictly speaking, correct. To see this, let us suppose that the cost to the company of putting an annual horse-power into their mains is £20, and they get £30 for every annual horse-power taken by the customer. Now, if I lose 1 H.P., shall I be right in writing off this loss at £20? Clearly not ; for if I had not lost this particular horse-power, I might have sold it for £30. But there is another way of looking at this. You might say that the £10 difference between the cost and selling price of power represents profit and interest of plant and mains, and that, therefore, the lost power should be debited at net cost. To this I reply, that my object is not to put power into the mains, but to take power out, or, rather enable my customers to take power out, for which they will pay me ; and so we might keep arguing the question, without ever coming to a definite understanding. Now, if we cannot settle such a simple problem by common-sense reasoning, there must be something wrong in our premises ; and in this case, it is not difficult to see where the hitch is. It is in the assumption that the power has a constant value. In reality, this is never the case. If it were the case—that is to say, if one horse-power had the same value at the motor end as it has at the generator end of the line—it would be perfectly useless to establish a transmission plant ; it would be like carrying coals from Cardiff to Newcastle. It is only because the power has a great value at the motor end of the line, and a small value at the generator end, that it will pay us to lay out capital in plant, and incur the risk of working it.

Under no circumstances will it be economical to lose more than half the total power in the line.

The correct way of treating this problem is, therefore, to take into account the cost of the power, both at the generating and at the receiving station. We must, further, take into account not only the interest and depreciation of the line, but also the interest and depreciation of the machinery at either end ; and, in estimating these items, we must know at what voltage the plant is to work, and what total power is required ; for the prime cost per horse-power depends very materially on the total power and voltage. To make this clear : if I want to reduce the capital outlay on the line, I must work at high voltage, and with a large energy loss. This means that I must put down a larger generator than would otherwise be required, and, moreover, one that gives a high pressure current. It is thus quite possible that what I save in the line I shall have to expend at the generating station, to say nothing of the increased charge for waste power, and the greater liability to have a breakdown, owing to high voltage.

You see this problem is a very complicated one ; and Thomson's law, which says nothing about voltage or cost of machines, will not fit it. It is, however, possible to amend this law, so as to obtain at least an approximate solution. The premises on which the formula has been deduced are as follows :—

Conditions given.—Annual value of brake horse-power at generating station ; voltage at generator terminals ; brake horse-power required at motor end ; distance of transmission ; cost per horse-power of machines and regulating appliances at the given output, and voltage ; cost of conductor, per ton of copper erected, interest, and depreciation of whole plant.

Data required.—Working current, brake horse-power at generating station, mechanical efficiency, voltage at motor, total capital outlay per brake horse-power delivered, and cost of annual brake horse-power.

The efficiency of each machine is assumed to be 90 per cent. The formula gives only the current, but the other data can be found by very simple calculations, which need no explanation. The cost of supports for the line per mile, whether overhead or under ground, can be taken as constant, that is, not depending on the exact current within the limits, which can easily be foreseen in each case ; and it therefore does not enter into the formula for the current. Interest and depreciation I have taken the same for all parts of the plant, so as to avoid too great a complication of the formula. If you now work out by the aid of the current formula the same transmission problem for different voltages, you will find that there is one particular voltage for which the annual cost of the brake horse-power delivered at the motor end of the line is a minimum ; and, provided this voltage is within reasonable limits, it ought to be adopted. When making such calculations, you will find that the greater the cost of power at the generating station, the higher is the most economical voltage, this voltage also, of course, increasing with the distance.

Each case must be worked out with due regard to local conditions, and nothing in the shape of cut and dried rules or figures can make this work superfluous. On the other hand, it is very desirable to collect information as to the cost of works which have actually been carried out, and by the liberality of Mr. Brown, the engineer to the Oerlikon Works, Switzerland, I am able to place before you some figures of this kind which are contained in the following table. The figures give the whole

capital outlay for the electrical parts of some of the power transmissions erected bythis firm :—

COST OF TRANSMISSION OF POWER PLANT.

Distance in miles.	H.P. Delivered.	Speed of Machines.	Cost in £. Gen.	Mot.	Line.	Total Cost.*	Cost per H.P.
1·870	85	450	640	560	440	£1,880	£22·2
·280	195	500	760	680	132	1,800	9·7
·280	51	600	320	280	60	720	14·1
·375	90	550	520	480	80	1,240	13·8
·560	71	600	440	400	60	1,040	14·6
·280	40	700	260	240	20	640	16
·375	75	600	480	440	68	1,120	15
·500	87	500	520	480	100	1,260	14·5
1·560	150	600	760	720	330	2,050	13·7
·220	93	450	440	420	232	1,270	13·7
6·250	11	900	132	110	480	960	87
2·200	51	600	360	320	300	1,140	22·4
·187	60	900	240	220	18	600	10
5·000	41	750	240	200	344	1,020	24·8
3·750	220	600	1,040	960	640	2,960	13·5
·002	15	600	112	104	8	252	16·8
·250	19	700	160	160	20	390	20·5

* This includes regulating apparatus, instruments, posts, insulators, lightning arresters, erection and supervision.

TORONTO BRANCH C. A. S. E.

The last regular meeting of the above society was held on Friday evening, February 12th, President A. E. Edkins in the chair.

On motion the general routine of business was postponed until next regular meeting. This was done in order to give the members a chance to hear Mr. G. C. Robb, Chief Engineer of the Boiler Inspection & Insurance Co. of Canada, who had been kind enough to promise to give them a "talk" on "Steam Boilers, and What Takes Place during the Process of Getting up Steam."

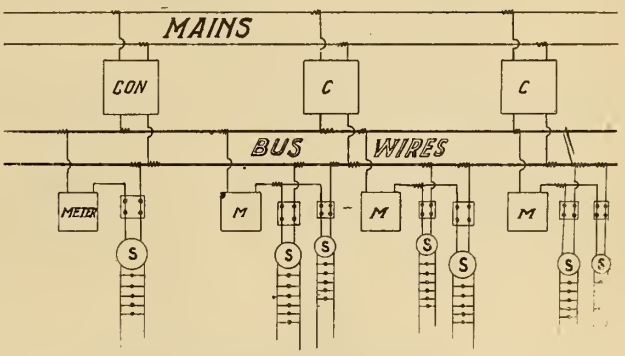
Mr. Robb made frequent use of the black-board for purposes of illustration, and for two hours remained on his feet and held the attention of his listeners. Those who know Mr. Robb will readily understand how difficult it would be to listen indifferently to an address from him on this subject. He has the faculty of easily conveying ideas to his hearers ; and, taking into consideration the experience, both practical and theoretical which he has had in connection with steam engineering, it is not difficult to foresee the good which must ultimately result from lectures of this kind to practical working engineers.

The attendance at the meeting was not as large as it might have been, owing in a measure no doubt to the severity of the weather.

At the termination of the lecture a hearty vote of thanks to the speaker was unanimously carried. Mr. Robb in reply, assured the members that he was very glad to be of service to them and while modestly claiming to be (like themselves) a student in steam engineering, would be most happy to meet them again in the near future.

CONVERTERS IN PARALLEL.

For the information of those whose experience has not extended so far that they are loth to do other than just what they are told to do when an alternating plant is purchased or installed, we desire to point out that it is possible in putting up converters for supplying a large number of lights in any vicinity, to connect one or more large converters or transformers, or a number of small ones in parallel or multiple, to accomplish such supply, and with the best results. This is known as "banking" them, or as a "bank of converters." If the current is being supplied by meters they can also be "banked," in which case it becomes necessary to connect the conveters to what may be



called bus-bars, and the supply is taken from the bus-bars through the meters, which may be arranged to supply any number of circuits. This is fairly well illustrated by the accompanying sketch, this arrangement being at present in use for supplying some 200 lights in a large church.

The example set by the Plymouth chamber of commerce has been followed by the Halifax and Bedford chambers, who have proposed resolutions calling upon the government to buy-up the telephones of the country.

The Toronto Incandescent Electric Light Co. announce that with the object of securing satisfactory work, they have established a wiring department.

The report of the Citizens' Committee on rapid transit for Chicago brought out the fact that Port Arthur, Ont., is the only city in America operating its own street railway.

The contract for lighting the city of Quebec being about to expire, the Quebec and Levis Electric Light Co. proposes to advance prices $10 per lamp per annum, while the city talks of doing its own lighting.

An iron pulley on one of the dynamo machines in the new electric light station at Toronto Junction recently burst while running at full speed. The fragments flew in all directions, but the attendants miraculously escaped unhurt. The pulley was at once replaced by a Dodge Wood Split Pulley (ordinary stock), and the attendants now feel somewhat safe again. Moral—use Dodge pulleys.

SPARKS.

It is understood that a provincial tax will be placed on telephone and telegraph companies, by the government of New Brunswick.

An electric wire heated to the proper temperature is recommended as an efficient and economical improvement on present methods of cutting ice.

On the 2nd of February there was tested and operated at the Edison General Electric Co.'s works, Peterborough, Ont., a mining locomotive. The test was made amid a blinding snowstorm, and our informant states that the results were entirely satisfactory. This is the first and only electric locomotive manufactured in Canada.

Between 1887 and 1889 the number of telegraph offices in the United States was increased by 20 per cent., against an increase of 8 per cent. in England. in the United States there is one telegraph office to every 2,400 of the population; in England there is one to every 5,500. In England there is one office to every 17.27 square miles; in America one to every 171 square miles, the population per square mile being in the ratio of 100 to 5·6. The average mileage of a message in America is, however, 540 miles; while the longest possible distance in England is 600 miles.

A. Allan, President. J. O. Gravel, Sec.-Treas. F. Scholes, Man.-Director.

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MANUFACTURERS OF ALL KINDS OF

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WESTERN BRANCH:
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A SUBSCRIBER'S SUGGESTION.

PETROLIA, Jan. 21st, 1892.

Editor CANADIAN ELECTRICAL NEWS.

DEAR SIR,—Your note in this month's NEWS with regard to the bewilderment caused Mr. Justice Ferguson by the use of technical terms in his court, suggests to me to tell you that to many of your subscribers the greater part of the ELECTRICAL NEWS is utterly unintelligible. Many of us haven't what I suppose you would call the merest rudiments of electrical knowledge. There have been, it is true, explanations of the working of electricity, but they all assumed the reader to have some knowledge in the matter, and many words were used in a sense that conveyed no meaning to us. Now a dynamo, with the parts named and the use of each explained in simple language, would be a comfort to many of your readers. Hoping that you will accept the suggestion in as kindly a spirit as it is meant,

I am, yours respectfully,

J. A. L.

SAFETY VALVES—THEIR HISTORY, ANTECEDENTS, INVENTION AND CALCULATION.

By WILLIAM BARNET LE VAN.

(Continued from February number.)

As will be noticed in Fig. 23, pins are not used for the fulcrum, but knife edges are used, as shown, to transmit the pressure of the lever to the safety valve through a pin pointed at the bottom end. This arrangement is far preferable to that generally adopted where joint pins are used, and should come more generally into use.

The lever safety valve recommended by the Board of Supervising Inspectors of Steam Vessels, is represented in Fig. 24. The following directions are given regarding its construction:

All the points of bearing on the lever must be in the same plane. The distance of the fulcrum must in no case be less than the diameter of the

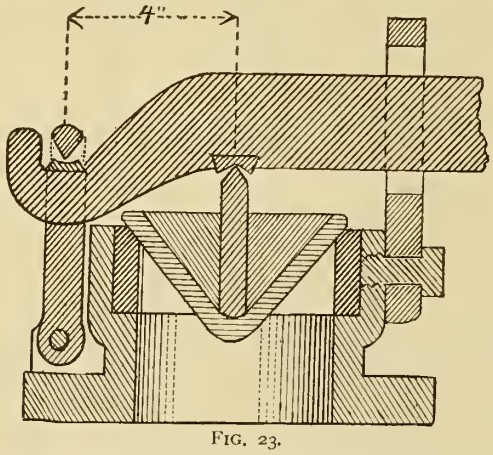


FIG. 23.

valve opening. The length of the lever should not exceed the distance of the fulcrum multiplied by 10. The width of the bearing of the fulcrum must not be less than ¾ of an inch. The lever of the fulcrum link should not be less than 4 inches. The lever and fulcrum link must be made of wrought iron or steel, and the knife-edged fulcrum points and bearings for the points must be made of steel, and hardened. The valve sit, and bushings for the stem or spindle, must be made of composition (gun metal) when the valve is intended to be attached to a boiler using salt water; but when the valve is to be attached to a boiler using fresh water, and generating steam of a high pressure, the parts named, with the exception of the bushings for the spindle, may be made of cast iron. The valve must be guided by its spindle, both above and below the ground seat, and above the lever, through supports either made of composition (gun metal) or bushed with it. The spindle should fit loosely in the bearings or supports. When the valve is intended to be applied to the boiler of steamers navigating

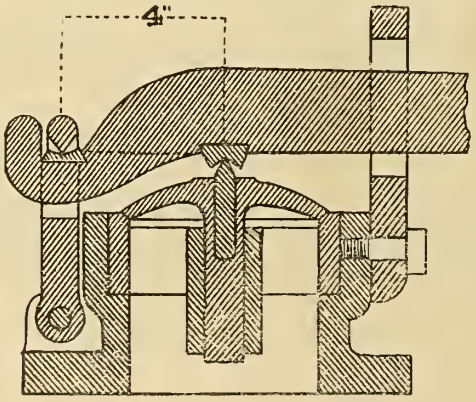


FIG. 24.

rough waters, the fulcrum link may be connected directly with the spindle of the valve, provided always that the knife-edged fulcrum points are made of steel and hardened, and that the object sought by the link is obtained—namely, the vertical movement of the valve, unobstructed by any lateral movement. In all cases, the weight must be adjusted on the lever to the pressure of steam required in each case by a correct steam gauge attached to the boiler. The weight must then be securely fastened in its position, and the lever marked for the purpose of facilitating the replacing of the weight, should it be necessary to remove the same.

A PERFECT SAFETY VALVE.

A perfect safety valve is one which will rise as soon as the pressure at which it is set is attained, that will prevent the pressure increasing if the boiler is forced to its utmost extent, and that will close promptly as soon as the pressure commences to fall. With all the experience of engineers, it seems impossible to design a valve possessing all the above features; but no doubt it can be closely approximated to.

TABLE OF AREAS OF VALVES OF DIFFERENT DIAMETERS.

Diameter of Valve. Fractions.	Decimals.	Circumference of Valve in Inches. Decimals.	Area of Valve in Square Inches. Decimals.
1-32	0.03125	0.0981	0.00076
1-16	0.0625	0.1963	0.00306
⅛	0.125	0.3926	0.01227
3-16	0.1875	0.5890	0.02761
¼	0.25	0.7854	0.04908
5-16	0.3125	0.9817	0.07669
⅜	0.375	1.1780	0.1104
7-16	0.4375	1.374	0.1503
½	0.5	1.578	0.1963
9-16	0.5625	1.767	0.2485
⅝	0.625	1.963	0.3067
11-16	0.6875	2.159	0.3712
¾	0.75	2.356	0.4417
13-16	0.8125	2.532	0.5184
⅞	0.875	2.748	0.6013
15-16	0.9375	2.945	0.6902
1	1	3.1416	0.7854
1 1-16	1.0625	3.3379	0.8861
1⅛	1.125	3.5343	0.9940
1⅛	1.1283	0.000	1
1 3-16	1.1875	3.7306	1.1075
1¼	1.25	3.9270	1.2271
1¼ Full	1.2611	3 9564	1.25
1 5-16	1.3125	4 1233	1.3529
1⅜	1.3667	4.2945	1.4625
1⅝	1.375	4.3197	1.4848
1⅜	1.382	4.3394	1.5
1 7-16	1.4375	4.5160	1.6229
	1.4912	4.6817	1.75
1½	1.5	4.7124	1.7671
1 9-16	1.5625	4.9087	1.9175
	1.5957	5.0083	2
1⅝	1.625	5.1051	2.0739
1 11-16	1.6875	5.3014	2.2365
	1.692	5.3128	2.25
1¾	1.75	5.4978	2.4052
	1.7823	5.5954	2.5
1 13-16	1.8125	5.6941	2.5801
	1.86	5.8407	2.75
1⅞	1.875	5.8905	2.7611
1 15-16	1.9375	6.0868	2.9483
	1.9537	6.1324	3
2	2	6.2832	3.1416
	2.034	6.3867	3.25
2 1-16	2.0625	6.4795	3.3411
	2.1105	6.6254	3.5
2⅛	2.125	6.6759	3.5465
	2.1838	6.8452	3.75
2 3-16	2.1875	6.8722	3.7582
2¼	2.25	7.0686	3.9760
	2.256	7.069	4.
2 5-16	2.3125	7.2649	4.2001
	2.3248	7.2848	4.25
2⅜	2.375	7.4613	4.4302
	2.3934	7.5040	4.5
2 7-16	2.4375	7.6576	4.6664
	2.4416	7.6616	4.75
2½	2.5	7.8540	4.9887
	2.525	7.9280	5
2 9-16	2.5625	8.0503	5.1573
	2.5842	8.1012	5.25
2⅝	2.625	8.2467	5.4119
	2.646	8.3084	5.5
2 11-16	2.6875	8.4430	5.6727
	2.7049	8.4937	5.75
2¾	2.75	8.6394	5.9395
	2.7636	8.6758	6
2 13-16	2.8125	8.8357	6.1226
	2.82	8.8548	6.25
2⅞	2.875	9.0321	6.4918
	2.8764	9.0365	6.5
	2.9305	9.20	6.75
2 15-16	2.9375	9.2284	6.7772
	2.9835	9.3666	7
3	3	9 4248	7.0686
	3.0365	9.5330	7.25
3 1-16	3.0625	9.6211	7.3662
	3.0884	9.6963	7.5
3⅛	3.125	9.8175	7.6699
	3.139	9.8596	7.75
3 3-16	3.1875	10.0138	7.9798
	3.19	10.0160	8
3¼	3.25	10.2102	8.2957
	3.288	10.3243	8.5
3 5-16	3.3125	10.4065	8.6179
3⅜	3.375	10.6029	8.9462
	3.384	10.6257	9
3 7-16	3.4375	10.7992	9.2806
	3.47	10.8958	9.5
3½	3.5	10.9956	9.6211
	3.77	11.8378	10
4	4	12.5664	12.5654
	4.371	13.725	15
4½	4.5	14.1372	15.9043
4¾	4.75	14.9226	17.7205
5	5	15.7080	19.6350
	5 047	15.8475	20
5½	5.5	17.2788	23.7583
	5.642	17.7058	25
6	6	18.8496	28.2744
6	6.375	20.0175	30

SPRING-LOADED SAFETY VALVES.

I have in my former articles given a description of those safety valves which are held to their sits against internal pressure by weights, either act-

ing directly or through levers, and which are most generally in use on stationary and marine boilers. I now propose to give the history of those which are held to their sits against internal pressure by springs, either acting directly or through levers, used almost exclusively upon locomotives, and to a great extent on portable and marine boilers.

As before stated, safety valves were employed by Papin in 1680, and are, therefore, two hundred years old, and, as shown, probably much older.

The objections to spring safety valves are, that the compression of the spring is increased with the lift of the valve, and therefore the pressure holding it down to its sit becomes greater the higher the lift, and as the weight of a dead load is constant for any height of lift, the amount of lift of a given valve for any pressure would be less with a spring than with a constant weight. Therefore, boilers with spring-loaded safety valves should be loaded at a certain per cent. below the blowing-off point; or, in other words, suppose a boiler should be allowed, according to law, to carry 100 pounds pressure per square inch, the spring on the valve, to lift the proper height to free the boiler at that pressure, should be set at 95 pounds, as the accumulated pressure due to the increased compression of the spring will be 5 pounds; and as the valve would blow off at 95 pounds, that would be the working pressure of the boiler, although the limit to which the pressure could accumulate would be 100 pounds per square inch.

Looking at it in this way, the strength of the boiler should be increased or the load upon it reduced, as compared with the practice of dead-loaded safety valves.

The amount of pressure accumulated with spring-loaded valves is a less percentage of the pressure the higher the pressure rises, and there is soon reached a pressure at which the percentage of accumulation becomes so small as to be of little practical importance.

In the United States navy yard experiments, made with spring valves, it was found that the percentage of accumulation at 34 pounds, was 19 pounds; at 59 pounds it was 9.4 pounds; at 80 pounds it was 6 pounds; and at 90 pounds it was 5 pounds.

With the advanced state of boiler engineering, the majority of good boilers have a factor of safety of *six*—that is to say, the working pressure of the boiler is one-sixth the bursting pressure. At 75 pounds per square inch working pressure, we have a bursting pressure of $75 \times 6 = 450$ pounds, and a percentage of accumulation upon the load pressure of the spring-loaded valve of say 8 per cent.; that is, $75 \times 8 = 600$ pounds; $75 + 6 = 81$ pounds. The highest pressure to which steam can be carried in such a boiler, with a properly proportioned spring valve loaded to 75 pounds per square inch is

$$\frac{450}{81} = 5.62, \text{ the factor of safety,}$$

leaving still an enormously large margin of strength before reaching the point of explosion.

The makers of spring-loaded safety valves argue that the pressure of accumulation is the same in dead-weight valves as in spring-loaded valves. If they will but stop and think for a moment, they will see that in the dead-loaded valves the resistance is constant, regardless of the lift of the valve;

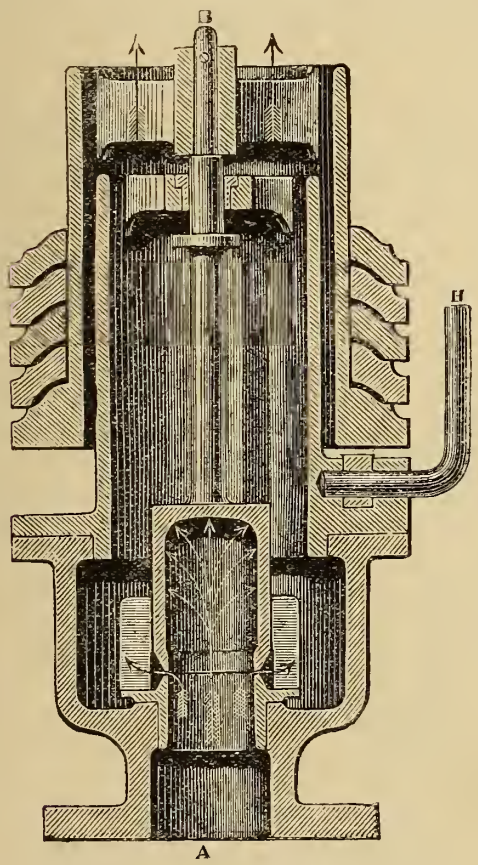


FIG. 25—DEAD-LOAD OPEN FLOW VALVE.

but with the spring-loaded valve, as commonly made, the slightest proportion of lift compresses the spring, and the pressure, acting against this lift, varies directly with the amount of that lift. Therefore there can be no doubt that the pressure of accumulation is greater in the case of the spring-loaded than the dead-loaded valve, all circumstances being the same.

To overcome this increase of pressure as the valve rises, it is necessary to increase the area of the valve with its lift, or to arrange that the increased compression of the spring may be compensated in some other way. The form of valve shown in Fig. 25 has been put on the market to overcome the above difficulty.

If the contact between a safety valve and its sit were the contact of two sharp edges, like two circular knives edge to edge, the action of a valve in opening and closing would be simpler than it can generally be in practice. In fact, the surfaces in contact must have, for constructive reasons, a breadth very considerable in proportion to the diameter closed by the valve; and since the areas of circles are to each other as the squares of their diameters, the area of the circle circumscribed by the outer border of the valve sit is materially larger than the area bounded by the inner border of the valve sit. The smaller area alone, wholly within the sit, is acted on by the confined steam while the valve is closed; the larger area, within the outer border of the sit, is acted on by the escaping steam while the valve is open. It was, therefore, not unnatural to suppose that a safety valve, once opened against a resistance nearly constant, would then open more widely, so as to give free outlet to the steam, and that it would remain open until a very sensible reduction of pressure in the boiler should enable a force, at first overcome by the higher pressure on the smaller area, to overcome in its turn the reduced pressure on the larger area.

That the reverse is true is well known. A safety valve, opened so as to permit the escape of a thin film of steam, can be further lifted so as to permit the free escape of steam, only by considerable increase of pressure, or by some special contrivance. It is usual to explain this phenomenon entirely by the increased resistance of springs due to increased tension; but this cannot be the sole cause, since the same thing is observed in a less degree where weights are used to close the valve. An additional cause is to be found in the expansion of a film of escaping steam between the valve and its sit, as in the familiar "pneumatic paradox," described by Bourne as "the tendency which escaping steam has to shut the valve down." There is also a little sluggishness and hesitancy about a movement produced by a very slight preponderance of nearly balanced forces. All motion is attended with some friction and some inertia; and decided preponderance is required to produce decided movement. To counteract this inertness, and to give promptness and decision—in a word, to give "prop!" to the action of a safety valve, both in opening and in closing, many expedients have been invented.

REACTIONARY SAFETY VALVES.

The construction of reactionary safety valves is such that the steam, after passing the ground-sit of the valve, and prior to its final exit into the atmosphere, is opposed by a "stricture," so to speak, which stricture generally consists of an extension of the valve beyond the ground sit, and curved downwards; but in some instances is either straight or beveled, and a corresponding extension of the casing curved upwards.

One of the first in this line of improvement was an Englishman named Charles Ritchie, whose patent is dated March 2, 1848, and numbered 12,078. Ritchie's safety valve (Fig. 26) shows an annular lip, or flange, extending all around the valve, an annular chamber for escaping steam ex-

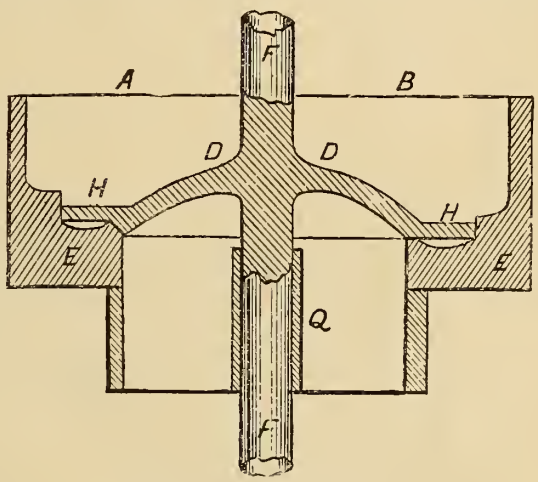


FIG. 26.—THE RITCHIE VALVE.

tending all around the valve sit under the lip of the valve, and a "stricture," formed by a cylindrical ring rising from the outer border of the annular chamber, and encircling the lip, or "compensation flange," as its inventor calls it, so that steam, after passing in a thin film through the slightly-opened ground joint, is gathered, or "huddled," in the annular chamber, thereby soon acquiring the full existing pressure within the boiler, or nearly so; and pressing upon the entire area within the outer border of the lip, overcomes the increasing resistance of the spring, lifts the valve so high that its lip surmounts the constricting ring, and permits steam to escape all around a circle of larger periphery than that of the ground joint—the circumference, namely, of the constricting ring. When the desired relief has been obtained, and the pressure within the boiler has fallen by the amount provided for by the proportion of the lip to its valve, the spring closes the valve—slowly at first, and then promptly—giving the kind and degree of action to be desired.

The description of its operation, given in the specification, shows clearly a complete understanding of its principles on the part of the patentee. He says: "As soon as the pressure of the steam raises the valve from its sit, the flange H, being exposed to the pressure of the steam, presents an increased surface, which compensates for the increasing resistance of the helical spring (which surrounds spindle F, but not shown in cut), until the valve has been raised to a height equal to the area of the steam way, when it allows the steam or vapor to escape freely.

(To be Continued.)

Electric heaters have been successfully introduced in the electric street cars at Ottawa.

A portable telephonic apparatus for use in coal and other mines has been devised by M. Berthon. It consists of an oak box with handles. The box contains a magnet in connection, a "call" arrangement, an alarm bell, an induction coil, switch for the microphone battery, three cells in ebony cases, terminals for making connection with a wire conductor, and the well known Berthon-Ader apparatus. The whole is placed in a leather case provided with straps for convenience in carrying. With a well insulated conductor carried down the shaft, and with the employment of "flying" or portable wire, communication with those on the surface is possible with the Berthon apparatus for any part of a mine.

To show the capacity of incandescent lamps to withstand the weather, Mr. W. Claude Johnson writes to *The Electrician* as follows: "I have maintained one of these lamps for four years in a most exposed condition in my garden without any difficulty. The lamp is rigidly fixed at the top of a tubular shaft. . . . A concentric cable passes through a gland at the top of the shaft, where the lamp is fixed in a vertical position. The cable is connected directly to the platinum loops of the lamp, the joint being then neatly wrapped with pure para rubber strip, and over this a layer or two of compound tape, which encloses a small portion of the glass bulb."

THE STORAGE BATTERY FOR STREET RAILWAYS.

[*Continued from page 35.*]

thorough test at the Toronto Electric Light Company's works, including a compartment for the cells—such compartment being provided with two locks and a key to be given to each of the experts. By this means it will be impossible for one of the experts to open the compartment containing the cells without the presence and assistance of the other, and a guarantee of the fairness of the test will thereby be assured.

We are in a position to enter upon the test immediately on the acceptance by you of the above conditions, and the appointment of the expert whom you desire to represent you.

Such a test will result in bringing your battery prominently before public notice, and should its merits be what you claim, will undoubtedly bring you large financial reward.

We will be pleased to publish as fully and as widely as possible the results of the proposed test.

We will willingly make right any injustice, if such has been done to you, in our editorial of last issue.

Kindly let us hear from you on the subject of the above proposition at your earliest convenience, and oblige,

Respectfully yours,

C. H. MORTIMER.

TORONTO, 10th Feb., 1891.

C. H. MORTIMER, ESQ., Toronto.

DEAR SIR,—Replying to your favor of the 9th inst., we beg to say that Mr. C. Gordon Richardson has consented to act for us in the matter of testing the battery. We think, however, that the test should take place on perfectly neutral ground, and beg to propose the School of Practical Science, Toronto University. Every appliance necessary for a thorough and exhaustive test will be placed at the disposal of Messrs. Wright and Richardson, and would, we think, be preferable in every way to the place you suggest.

Referring to the number of cells you propose, fifty seems entirely unnecessary to us. I think, perhaps, that had better be left to the experts to decide upon. Awaiting your reply.

Yours truly,

THE ROBERTS STORAGE BATTERY AND ELECTRIC CONSTRUCTION CO.
By C. N. Sutherland.

TORONTO, Feb. 12th, 1891.

ROBERTS STORAGE BATTERY
AND ELECTRICAL CONSTRUCTION CO., City.

DEAR SIRS:—Replying to your letter of the 10th inst., I have no objection to the test of your storage battery being made at the School of Practical Science, provided the authorities of that institution are willing to furnish the necessary facilities for a sixty days test. Of course as this test is to be made with particular reference to the adaptability of the battery for street car work, the conditions will have to be made as similar as possible. Therefore I think that fifty cells would be required. It will be necessary to know the weight of cells you propose to use for an ordinary street car. The rate of discharge would then be proportioned to the number tested. The average number of amperes required in practice can be ascertained from companies operating electric railroads at present. The load would also be required to be thrown on and off the motor or other resistance at frequent intervals as would be the case in ordinary practice.

Kindly let me know if the management of the School of Practical Science are willing to provide facilities for this being done, and I will get Mr. Wright to meet your expert at once and arrange details.

Respectfully yours,

C. H. MORTIMER.

TORONTO, 13th Feb., 1891.

C. H. MORTIMER, ESQ., Toronto.

DEAR SIR,—We beg to acknowledge receipt of your favor of the 12th inst., and learn for the first time that the test you propose making was with particular reference to the adaptability of our battery for street car work, any more than its ability to stand the heaviest charge and discharge rates, its capacity, efficiency and commercial return, and we are unable to see how you are to get any more information than this in the test you propose of 50 cells. As one cell or twelve if you wish will give this information, we are at a loss to know why you required fifty.

As we informed you the other day, we have now an exhibition storage car under way, and will place it on the tracks in this city as soon as possible, and we think we are justified in saying that this will be a more practical and in every way satisfactory test of the adaptability of our battery for street car work, than the test of 50 cells you propose.

We will be glad, however, to have a test made of our battery at the School of Practical Science, and will be pleased to know when and where Mr. Richardson may meet Mr. Wright to arrange details.

Yours truly,

THE ROBERTS STORAGE BATTERY AND ELECTRIC CONSTRUCTION CO.
Per C. N. Sutherland.

ROBERTS STORAGE BATTERY
AND ELECTRICAL CONSTRUCTION CO., City.

TORONTO, Feb. 17th, 1891.

DEAR SIRS:—Replying to your letter of the 13th inst., I see no necessity for prolonging this correspondence by haggling over details. I made a proposition to you to submit your battery to a thorough test, stating the general conditions under which in my opinion the test should take place. I further offered to provide all the facilities for making such a test. It rests with you either to accept or reject my proposition. After finding all manner of fault with my conditions, you offer in the concluding paragraph of your letter to have a test made at the School of Practical Science. Again I ask to be informed whether you have satisfied yourselves that the management of the School of Science have it in their power to provide facilities for such a test as I desire, whether they are willing to place such facilities as would be necessary at your disposal, and at the disposal of the experts, for the purpose. Lastly be kind enough to state distinctly whether you are willing to submit 50 cells of your battery to a test of 60 days duration in accordance with my proposition. Life is too short to continue this correspondence indefinitely, therefore kindly facilitate matters by stating clearly and definitely what you are prepared to do with the proposition made to you, and oblige.

Respectfully yours, C. H. MORTIMER.

TORONTO, Feb. 25th, 1891.

THE ROBERTS STORAGE BATTERY
AND ELECTRICAL CONSTRUCTION CO., City.

DEAR SIR,—With regard to the objections made on behalf of your company by one of your representatives a day or two ago, to placing 50 cells at our disposal for a period of 60 days test, and desiring the period of the test to be lessened, I have to say that I have consulted Mr. Wright on the matter and he is of opinion that anything less than a 60 day test would be valueless for the purpose of establishing the wearing qualities of the battery.

If you are not agreeable to our proposition as stated in our letter and through the ELECTRICAL NEWS, it only remains for you to say so. As you state that it is your intention to make a test of your battery on a street car fitted up for the purpose in this city within five or six weeks from this date, I would suggest that in the event of your declining to accept the proposition I have made to you for a test, that you should allow my expert free access to the street car on which your proposed test is to take place. Awaiting your early reply, I remain,

Respectfully yours, C. H. MORTIMER.

C. H. MORTIMER, ESQ., Toronto. TORONTO, 26th Feb., 1891.

DEAR SIR,—I have only this morning returned to the city, and am in receipt of your letters of the 17th and 25th insts. In each of your letters you ask us to state definitely what we are prepared to do. In answer to this I beg to refer you to our letter of the 13th inst., which I think fully answers this question. In regard to the street car test, we have on more than one occasion informed you that we are now getting a car ready to put on the tracks here; the idea of testing the practicability of our battery for street car work on a stationary motor has never for a moment occurred to us. As a general test of the efficiency of our battery we have offered to place the necessary cells in the School of Practical Science for as thorough and exhaustive a test as can be made, and under the direction of Messrs Wright and Richardson. I quite agree with you as to life being too short to continue this correspondence indefinitely, but in view of the fact of our letter of the 13th inst to you having most fully and clearly stated just what we were prepared to do, I beg to suggest that any unnecessary correspondence is entirely due to either a desire upon your part to evade the question at issue or an entire misapprehension of the facts of the case. We shall be pleased to give Mr. Wright free access to our car at any time. I am, truly yours,

G. H. MACFARLANE, Man. Roberts Storage Battery Co.

ROBERTS STORAGE BATTERY
AND ELECTRICAL CONSTRUCTION CO., City.

TORONTO, March 2nd, 1891.

DEAR SIRS,—Replying to your letter of the 26th ult., in which you agree to place the necessary number of cells in the School of Practical Science for as thorough and exhaustive test as can be made of your battery, under the direction of Messrs. Wright and Richardson, nothing now remains to be done but that you should see that all the required facilities are provided at the School of Science for such a test as you describe. On receipt of your assurance that this has been done, we shall be happy to proceed immediately with the test. Awaiting your early reply, I remain,

Yours respectfully, C. H. MORTIMER.

C. H. MORTIMER, ESQ.,
Editor CANADIAN ELECTRICAL NEWS, Toronto.

TORONTO, March 5, 1891.

DEAR SIR,—Immediately upon receipt of your letter of March 2nd, I wrote Mr. Richardson informing him that you were ready to accept our proposition of test being made in School of Practical Science, and have just learned that he is absent from the city, but that my letter has been forwarded to him. As soon as we hear from him as to the day he will be here, we will let you know at once.

Yours truly,

THE ROBERTS STORAGE BATTERY AND ELECTRIC CONSTRUCTION CO.
By G. H. Macfarlane.

TORONTO, March 6th, 1891.

ROBERTS STORAGE BATTERY CO., City.

DEAR SIRS:—Your letter of the 5th inst. to hand and noted. It gives no assurance, however, that you have ascertained that the necessary facilities for such a test as we propose to make will be placed at the disposal of the experts by the authorities of the School of Science. I would suggest that you attain all information on this point at once, and by so doing prevent possible waste of time and perhaps the annoyance which would follow the discovery that owing to lack of necessary facilities, the test could not be satisfactorily carried out.

Yours truly, C. H. MORTIMER.

No reply has ever been received to our last communication on this subject, nor has the promised test of a street car ever taken place.

THE RIVAL OF THE POLE STAR.

WE are indebted to a correspondent for the following description of the electric plant at Edmonton, N.W.T.: Edmonton, Alberta, a village of 600 or 700 inhabitants, and the terminus of the Calgary and Edmonton railway, is the proud possessor of an electric light plant—proud because of the excellency of the plant and light and the fact that it is the most northerly thing of the kind on this continent, at any rate east of the Rocky Mountains.

A contract was entered into with the Royal Electric Company, of Montreal, on the 17th September, 1891, and on the 22nd of December the light was turned on and so far the company have not had a "shut down," a common occurrence with some plants in the N.W.T.

The plant consists of a 500 light alternator, 50 H.P. Leonard-Ball engine and 60 H.P. boiler. Owing to the scattered nature of the town, it took nearly six miles of main line to reach all the consumers. Over 300 lights are installed now, but it is expected that the machine will be on full load next autumn, as a mild boom is on the town, filling up the blank spaces with new buildings, and the light is highly appreciated in a place where the sun sets in the winter before 4 p.m.

Coal costs only $2.25 per ton, delivered at the furnace door, so dividends are confidently looked for by the shareholders even at the very low rates charged per lamp.

The place has just been incorporated and a contract for street lighting will shortly be entered into with the council.

An electric railway is to be built at Calgary, N.W.T.

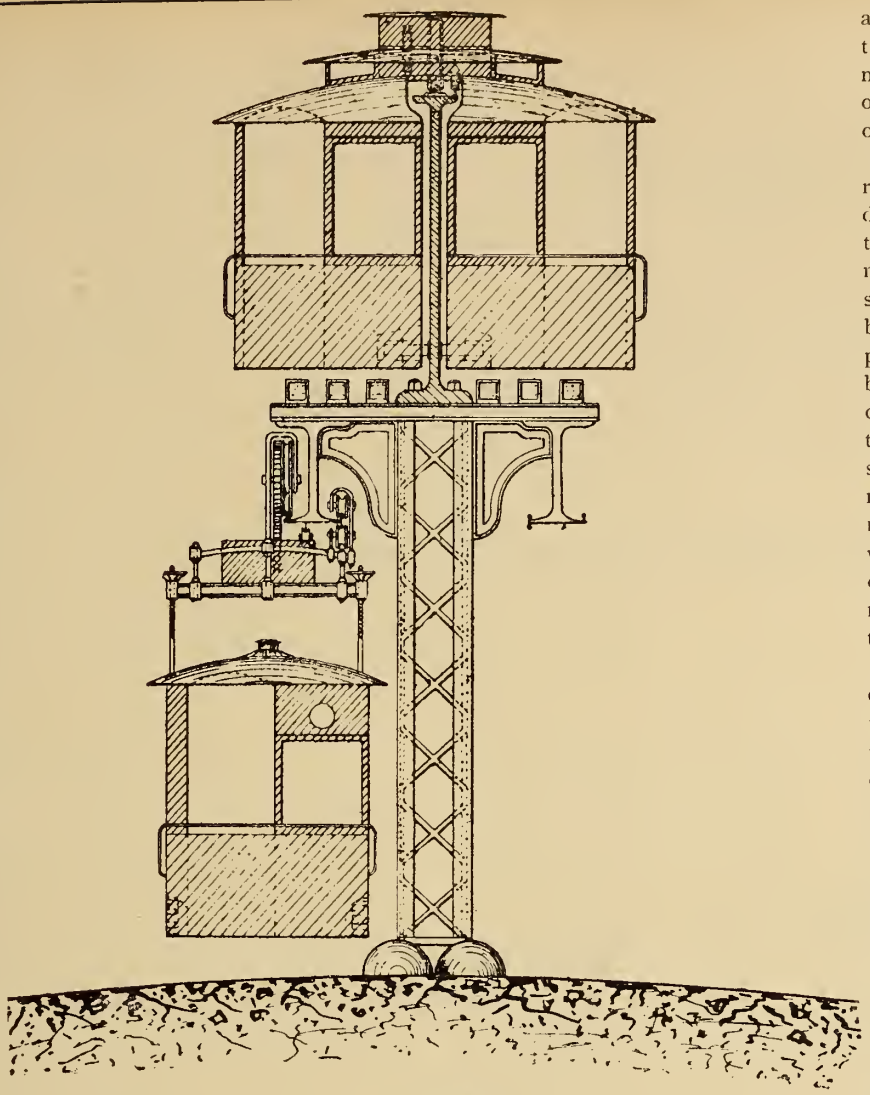
Supplementary letters patent have been issued to the North American Mill Building Company of Stratford, Ont., giving the company power to operate works for the production of electricity for light, heat and power.

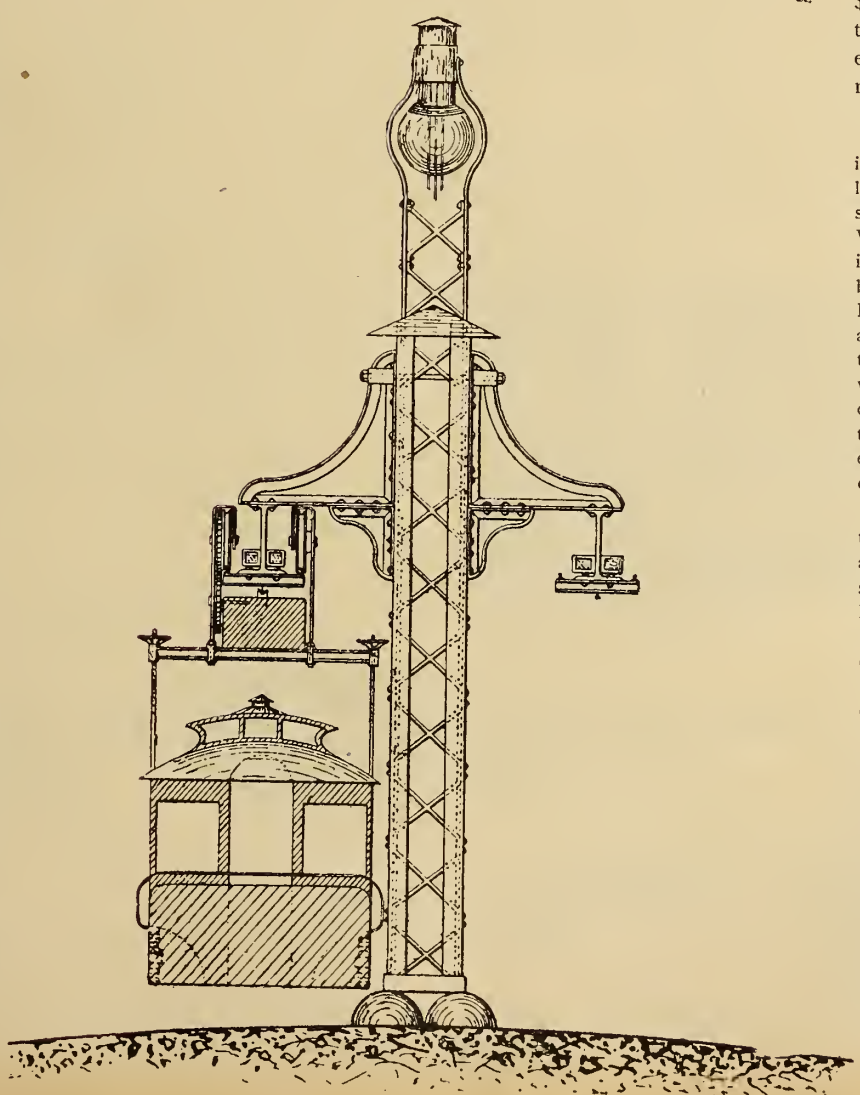
SUSPENDED STREET RAILWAY.

THE accompanying illustrations show a suspended or elevated street railway, the invention of Geo. R. Prowse, F. F. Kelly, J. Beaudry and Wm. Norris, of Montreal. The cut shows an end elevation of the post, with a suspended car having a single row of seats, for the city service, and an elevated car for fast suburban service. At suitable intervals an arched support may be affixed for electric light, so as to avoid disfiguring the streets with wooden posts.

The iron truss posts, firmly held under ground and placed at intervals along the centre of the street, support the whole combination. At the cross streets, an arched support of easy access may be provided for the electric light, in such a way as to not interfere with the passing of the cars. A double cross-arm extends on both sides of the post, supporting at its ends two longitudinal beams on which the cars run, going on one side and returning on the other; it carries on its centre the tracks of the fast suburban elevated electric car. Two longitudinal beams or girders span the distance between the posts, and support on the outer edge a single rail on which the car travels. There are two small guide rails on each girder to steady the car and prevent its lateral oscillation.

The suspended car being adjusted by regulators according to the amount of snow on the roadway, a small snow plough may be fixed to the front of the car so as to remove all the irregularities of snow drifting. The wheel is brought in contact with the live wire through mechanism in the hands of the driver,





and the electricity transmitted to the motor, acting either in one direction or the other.

The elevated car rests only on longitudinal joists without ties, so as not to throw much shade on the street, the steel rails being held in their position by iron rods bolted to them at a convenient interval, the service being absolutely that of ordinary electric surface railways. Indurated wood pulp being lighter and incombustible may be adopted for these cars.

Electric wire conduits are placed along the girders or longitudinal beams so as to do away with the wooden posts in the streets of towns and and cities, and also protecting the wires from induction or leaks.

The cost of construction of the suspended railway is supposed not to exceed $35,000 per mile, and the suspended and elevated $50,000 per mile.

A patent air brake, the invention of Major Chapleau, on something the same principle as the Westinghouse air brake, is being experimented with by the Ottawa Electric St. Railway Co.; if successful all that will be necessary to stop a car very quickly will be merely the moving of a controller similar to that used in turning on the electric current to start the car.

A new system of electric signalling, for marine and general use, has been shown at the Royal Naval Exhibition, by Mr. C. E. Kelway. A frame-work contains fifty-four incandescent lamps in six rows of nine each, and wires connect the lamps to a key-board like that of a type-writer. On pressing the proper key, the letter A is shown by the glowing of thirteen of the lamps arranged to form that letter. The other letters and the numerals respond in a similar manner when the corresponding keys are pressed, and messages spelled out may be read at a distance at night with great facility.

WHAT IS A DYNAMO?

THERE are no doubt quite a few men running electric light and power machinery successfully, who are at sea as to the manner in which each part of the dynamo performs its required duty, and also the relation which one part bears to the other, and how and why it produces an electric current for either supplying electric lighting by means of the lamps, or power by means of motors. The purpose of this article, then, is to make such an explanation as it is hoped will be the means of enlightening them in this particular. For this purpose there has been selected the plain Gramme ring armature machine; by Gramme ring is meant a type or pattern of one of the original dynamos built some 12 years ago by M. Gramme, of Paris, and which consisted of two electro-magnets, whose poles or extremities face each other, and between which is revolved a ring, consisting of either fine iron wires wound around a cast iron spider or frame, or laminas (layers) of sheet iron clamped together in the same position, and bolted to the spider or frame, this ring then being wound with insulated copper wire of proper size, for the current and voltage required, in a diametrically opposite direction to that occupied by the iron wire or laminas attached to the spider. This brings us to just what that armature has to accomplish in the part it plays; it is a well known fact that when a wire is passed over the face of a magnet, that a current is produced or generated in that wire, and as the armature in the above case is nothing more or less than a succession of wires lying side by side around the entire ring, which ring is revolved between the faces of the poles of the magnet, it will readily be seen that as they pass along the face of the magnets a current is continuously produced therein, which current will flow in either a positive or negative direction, accordingly as either the positive or negative pole is being passed by the wire or wires. Every one of these wires that are passing in front of the magnet being after all only a continuous winding around the iron wire or lamina, it also follows that each one of the windings is collecting, as it were, a certain amount of current from such magnets, and as this current must have an outlet to produce a commercial product, the segments of the commutator with the brushes bearing thereon are so arranged that as these wires one after the other are about to pass out of the magnet's influence, they make contact with the proper segment and take the discharge from the wires to the line.

The fields or magnets spoken of above, are simply a mass of iron, either cast, or wrought, or laminated, wound with insulated copper wire, through which is passed continuously a small part (or all) of the current that is being generated by the armature as explained above; this then produces an electro-magnet, or in other words charges the iron of the field magnets with magnetism to saturation, or nearly so, in consequence of which we have the wires of the armature which are revolving in front of it charged with a current, as explained in the first part of this article.

The next question from one who is not posted would be, "why and wherefore does it cause a current to be generated in the armature?" to which it can be answered—simply because there is a magnetic circuit established from pole to pole through the intervening air space, which for convenience sake is called the passage of lines of force—invisible to be sure, but nevertheless known to exist—these lines always taking a direction from positive pole to negative pole, the cutting of which by the wires of the armature being then the cause of the current produced in those wires. These lines of force would take an extended rotary path, or to be more explicit, a widely separated one, were it not that the iron wire or lamina of the armature has such an attraction for them, that they are concentrated or bunched, and brought into close relation with one another, the result of which is that the copper wire of the armature has the advantage of being able to cut through nearly all of them: we say nearly all, because it is a well known fact that some dynamos are so constructed that their pole projections are so close together that there is more or less of a leakage of magnetic current from pole to pole that should and otherwise would pass through the armature and do service in increased current at the brushes. From the brushes the current passes to the line. Of course there are different windings and arrangement of armature wire than those spoken of above, but the principle governing all of them is about the same, be the dynamo an arc or an incandescent, an alternator, or a generator, be it either for 10 volts or 5000, or 1-100 ampere, or 1,000 amperes.

The electric magnet spoken of above is a mass of iron around which is placed spools of insulated copper wire, and through which is passed a current of electricity, either from a dynamo or a battery, which current makes the iron magnetic, but only as long as there is current passing through the wire; the moment the circuit is discontinued the magnetism in the wire ceases, hence the name electro-magnet, meaning a magnet produced by an electric current only.

The poles of a magnet is that part of the iron whose ends project through the spools of copper wire, so that some dynamos have two poles, others more, and as in the case of alternating current dynamos, some have quite a number, they being then known as multipolar (many poles) machines.

The commutator of a dynamo is that part of a machine on which the brushes bear for the purpose of collecting the current, and is, as in the above dynamo, composed of flat pieces of copper known as segments, which are built together in the form of a drum, and are clamped closely together around the shaft of the machine, being well insulated between each piece or segment by a layer of mica or some other non-conductor.

PERSONAL.

Mr. James Baird has been appointed engineer of the new water works plant at Woodstock, Ont.

The death of Mr. Geo. Worthington, founder of the New York *Electrical Review*, to whose instrumentality was largely due the founding of the National Electric Light Association and the New York Electric Club, caused a widespread feeling of regret in electrical and journalistic circles.

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SPARKS.

At Perth, Ont., a scheme is on foot to build an electric railway between Perth and Lanark, outside parties to furnish capital and own the road.

The promoters of the proposed electric railway between Hamilton and Grimsby will take no steps towards building the road until the city council of Hamilton grants their application for permission to use the streets.

With the aid of electric snow sweepers the management of the Ottawa Electric Street Railway have succeeded in keeping the road in excellent working order, and more than this, the streets traversed by the road are said to be in good condition for sleighing.

A Ball plant has lately been installed in Weller Bros.' furniture factory, Victoria, B. C. It consists of a Ball dynamo, wound for a low-tension circuit to carry fifty 16-c. p. incandescent lamps, switch boards, rheostats, meters, etc. Power for the dynamo will be supplied by the engine which operates the factory.

The courts have decided to suspend until April further proceedings in the case of Leonard vs. the Royal Electric Company, which is an action to recover $8,000 as the price of machinery furnished the defendant to establish its system in Three Rivers. This is to allow of action being taken by the defendant against the city of Three Rivers, which refused to accept the machinery.

Messrs. Drake, Jackson and Helweken, and Mr. John Campbell, are applying to the Legislature of British Columbia on behalf of two distinct companies for incorporation for the privilege of building and operating tramway lines between and within the cities of Vancouver and New Westminster. The company which Mr. Campbell represents also proposes erecting and operating a telephone and telegraph system in each of the cities mentioned.

THERE IS BUT ONE PORTLAND
Oregon, and it is best reached via Chicago and St. Paul over the through Sleeping Car Line of the Chicago, Milwaukee & St. Paul and Northern Pacific Railways. For further information apply to the nearest ticket agent or address, A. J. Taylor, Canadian Pass. Agent, 4 Palmer House Block, Toronto, Ont.

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Dixon's Belting Hand-Book mailed free on application.

The example set by the Plymouth Chamber of Commerce has now been followed by the Halifax and Bedford Chambers, who have proposed resolutions calling upon the government to buy up the telephones of the country.

The proposition is being made to construct an electric railway from St. Petersburg to Archangel, a well known port on the White Sea, and a distance of 800 kilometres, or 500 miles. The electric current is to be suppl ed by a series of generating stations, placed at intervals along the entire route. If 500 miles can be covered, why not 1,000 miles, or even across our own continent? Such will be the result before many years.

Two Edison phonographs have been placed in the Department of the Interior at Ottawa, and are being used there with great success for corresponding purposes. The letters are dictated into cylinders on the machine in the deputy's room and are reproduced on another phonograph in the correspondence room and typewritten. The transcripts can be verified, as the cylinders can be reproduced as often as may be desired. When the work of transcription is completed, the cylinders are pared off and are ready for use again.



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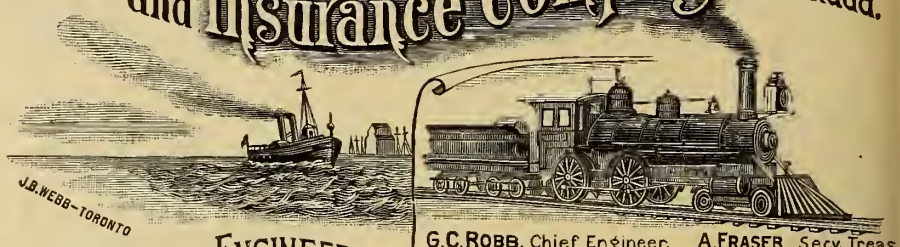
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Yours respectfully,

Windsor Water Works. JOSEPH HALL, Supt.

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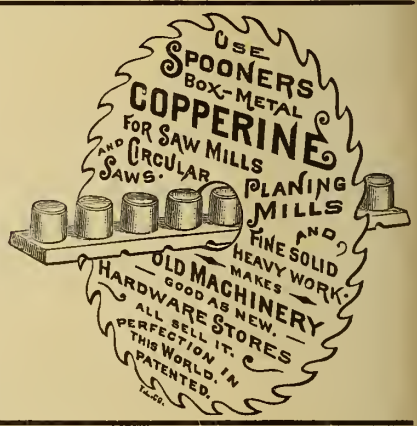
COPPERINE

Superintenent's Office, Water Works Dep't,
TORONTO, January 6th, 1891.

ALONZO W. SPOONER, ESQ.,
Port Hope, Ont.

DEAR SIR: I am pleased to say that after nearly three years' constant use day and night, on our largest engine, your Copperine has stood its work well. I have not had to renew any of the heavy bearings yet, so I consider that speaks for itself. I am pleased to recommend it to any one in need of metal to stand heavy work.

I am, yours truly,
J. C. FERGUSON,
Chief Engineer Toronto Water Works



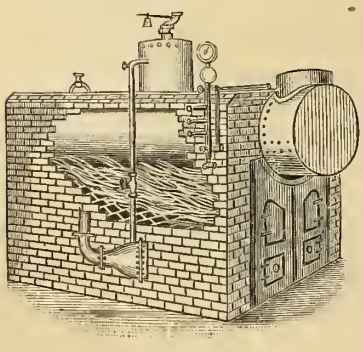
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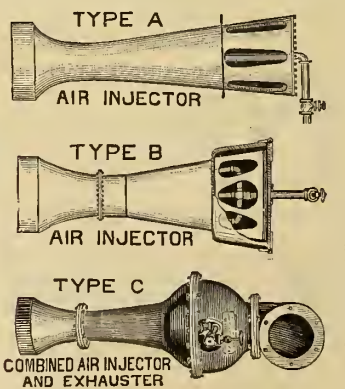
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DEAR SIR,—Please find enclosed herewith cheque for the combined Air Injector and Exhauster purchased from you. I am very much pleased with your invention; we have used other air injectors, also a fan for burning hard and soft coal screenings under our steam boilers, and prefer your device to any of them. It requires less steam and makes less noise in operation. My engineer uses it in the morning to start the fire with less than five pounds of steam shown on the steam gauge. This, together with the fact that it is independent of the engine and machinery and can be operated to its full capacity without running either, gives it a decided advantage over fans. I can safely recommend it to any one requiring a first-class blower.

Yours truly,
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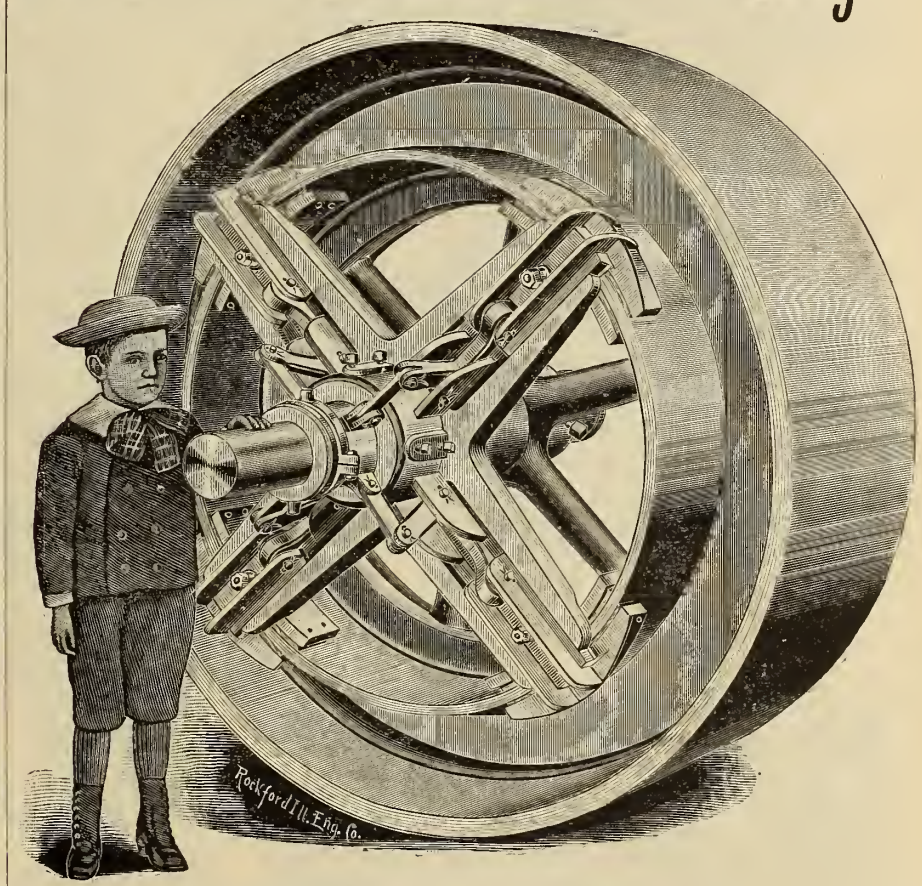
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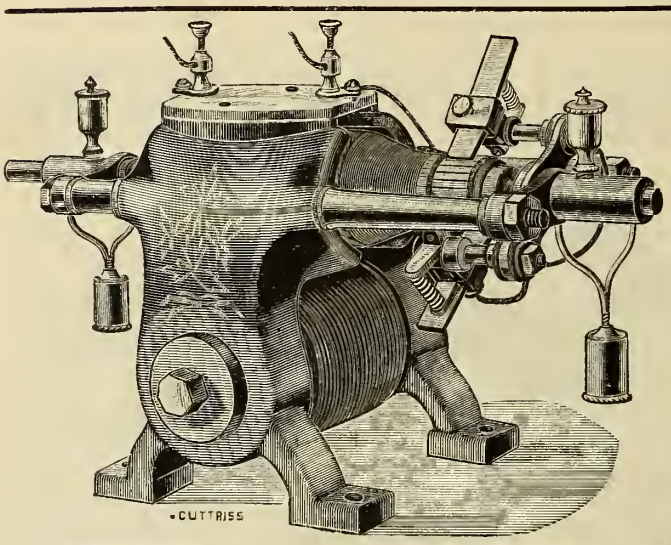
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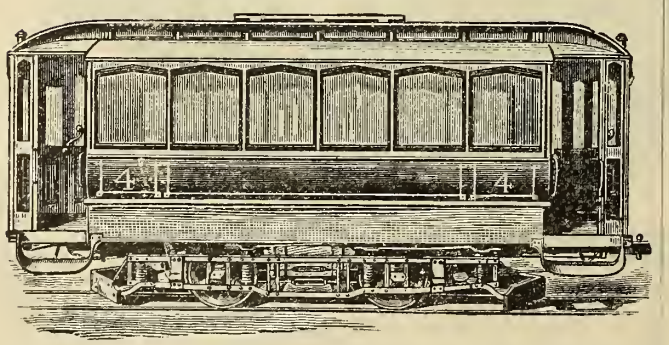
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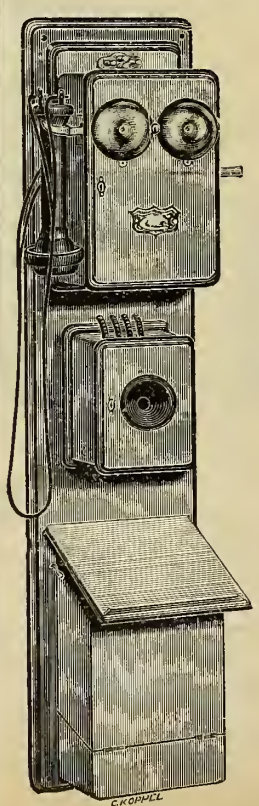
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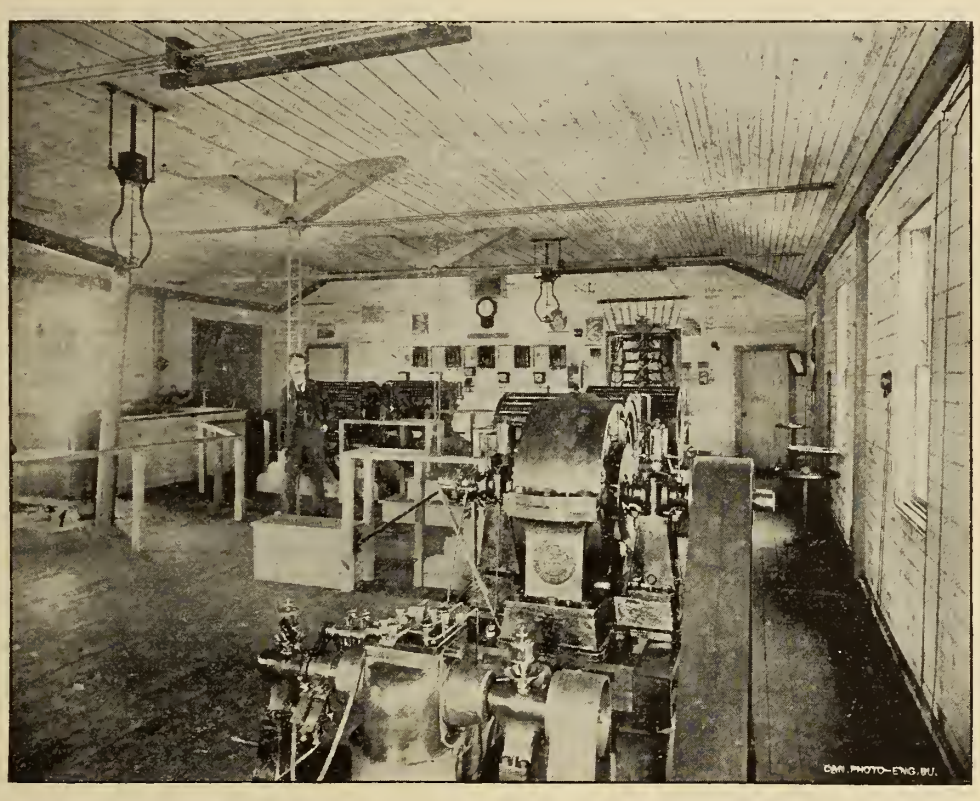
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VOL. II. TORONTO AND MONTREAL, CANADA, APRIL, 1892. NO. 4.

CENTRAL STATION OF THE PETERBOROUGH LIGHT & POWER COMPANY.

THE Peterborough Electric Light & Power Co., a view of the interior of whose station is herewith presented to our readers, was organized under the name of "The Peterborough Electric Light Co." in the year 1884, the first lights going into operation on May 24th of that year. The original management of the company consisted of: T. G. Hazlitt, President and General Manager; Messrs. Richard Hall, Wm. Walsh, A. P. Poursett, Directors. The Royal Electric Co., which installed the plant, placed one of their electricians in charge for the first year. The second year Mr. A. Brown had charge. Since 1886 Mr. H. O. Fisk, who obtained his electrical education in the Royal Electric Company's works in Montreal, has satisfactorily filled the position.



INTERIOR OF CENTRAL STATION, PETERBOROROGH LIGHT & POWER COMPANY.

In April, 1890, the company was amalgamated with the Gas Company, under the title of the "Peterborough Light & Power Co.," the officers of which are: T. G. Hazlitt, President; T. E. Bradburn, Vice-President; A. Stevenson, Secretary and General Manager; the Directorate being the same as before.

The building occupied by the company as their station was originally erected for the purpose of a pulp mill. It is located on the banks of the Otonabee river, the size being 40 x 70 ft., 2 stories, frame. The station is operated entirely by water power. There are used for this purpose five Leffel water wheels, four 52 in. and one 40 in., working under 11 ft. head. No trouble has been experienced in getting all the power required, nor has there been any perceptible variation of the power. The only difficulty which has been met with has arisen from the wheels becoming sheeted with ice on one or two occasions in the months of April and November. This seems to have resulted in consequence of the temperature of the atmosphere becoming suddenly lower than that of the water. When this occurred, the wheels would gradually become sheeted with ice until the bucket openings were entirely filled up and the wheels became perfect cylinders, when of course their usefulness was temporarily gone. The stoppages from this cause have only amounted, however, to about five hours in all, so that it is not a matter of much moment. Two of the wheels are coupled to one shaft, driving a 650 light alternator; each of the other wheels run two dynamos on an independent shaft. The 40 in. wheel runs a 40 light machine.

The dynamos are placed on the second floor, and consist of one 650 light alternating machine, with exciter, three 40 light, two 25 and one 12 arc light machine. The first mentioned machine is at present carrying 700 16 c. p. lamps. The wires from the dynamos are carried beneath the floor to the switchboard. There are behind the switchboard two folding doors, giving access at any time to the connections at the back of the board, also allowing of the potential of the different circuits being taken at any time by means of a bank of high resistance incandescent lamps in series and a Weston voltmeter, as well as insulation tests in daytime with Wheatstone bridge and galvanometer. These tests are made during all kinds of weather, and a record is kept of the results for future reference. Not only is a record kept of insulation tests, but also of each machine, and of the circuit on which it is working, the voltage between dynamo terminals, number of watts, electrical horse power, speed of the machine, and the load on each machine at time of test, the highest and lowest insulation test for the previous month, also the condition of the weather for the previous six hours, inside and outside temperature at time of test, with such other data as may be considered likely to be of value. These tests are made by means of a Weston ammeter and voltmeter, and one of Queen & Co.'s testing sets, and are all conducted by Mr. Fisk.

The company operate three street circuits, embracing about twenty miles of wire, two commercial circuits, each containing about four miles of wire, and an incandescent circuit covering the central portion of the town, and which is being extended to all parts of the town as fast as the circuits can be constructed.

The company have been using exclusively for more than a year past carbons made by the local manufactory of the town the Brooks Mfg. Co., and with the most satisfactory results.

There are in operation about 100 65 c. p. T. & H. series

lamps, 85 street lamps, 2,000 c. p., 75 of which are all night lamps, and 700 incandescents. Residential lighting has recently been commenced, and the outlook in this direction is said to be very promising.

RECENT CANADIAN PATENTS.

Geo. Cassidy, of Vancouver, B.C., has obtained a patent on a belt-joint, formed by cutting out of one end of the belt flatways a V-shaped gap, the other end inserted and cemented in said gap after shaping it to form an exact counterpart of said gap.

The Reliance Electric Mfg. Co., of Waterford, Ont., (Assignees of Frank Bankson Rae, Detroit, Mich.) have been granted a patent on a current indicator consisting of a magnet, the coils of which are included in the circuit to be measured. A semi-circular core-piece tapering from its base to its free end, a plate connected to the base and extending toward the free end of the core piece, an armature pivoted to the plate and carrying a ring shaped piece of soft iron embracing the core piece, and a pointer secured to the ring, and a segmental scale for the pointer.

A patent has been granted to Isaac Ives, Albany, P.E.I., for the combination on a water wheel of adjustable gates with their gate gear adjusted in an inner fixed case connected with tank, and the buckets, etc., fixed into the circumference of an annular wheel revolving horizontally around case, and fastened to shaft.

THE ELECTRICAL INTERESTS OF OTTAWA.

Ottawa is an interesting city from many points of view. Its situation is pleasant. It possesses in the Chaudière Falls one of the most wonderful water powers in the world, and around these falls are clustered saw-mills almost unequalled anywhere in point of capacity. Being the headquarters of Government for the Dominion, and the place of residence of the Queen's representative, it attracts many visitors. In conjunction with the twin city city of Hull, it can boast of a number of important manufacturing industries.

Second to none of its features of interest are its electrical enterprises, a few particulars of which we take the opportunity of presenting to readers of the ELECTRICAL NEWS. The latest addition to these is the recently constructed

ELECTRICAL STREET RAILWAY,

the perfect operation of which is an object lesson, the effect of which let us hope will not be lost on parliamentary representatives of other towns and cities.

The management of the road is as follows: J. W. McRae, President; G. P. Brophy, Vice-President; J. D. Fraser, Secretary-Treasurer. The road was constructed in less than two months by Messrs. Ahearn & Soper, of Ottawa, and notwithstanding the rapidity with which the undertaking was carried to completion, the workmanship in every particular is of the most substantial character. The road embraces eight miles of double and four miles of single track.

The equipment consists of sixteen cars of the vestibule type, manufactured by Messrs. Patterson & Corbin, of St. Catharines, Ont. The electric system employed is that of the Westinghouse Electric & Manufacturing Company, single reduction motors of 20 horse power each being used on each car. The dynamo room is located at the famous Chaudiere Falls, where two turbine water wheels drive two 100 horse power Westinghouse compound dynamos and a third machine is kept in reserve. The difficulty in supplying steady current by water wheels was at first a matter of serious difficulty as, owing to the frequent stopping of all or nearly all the cars at the same instant, the water wheels were liable to race. By an ingenious mechanical arrangement the water wheel gates are now raised and lowered instantly, and by the introduction of a novel electric device sufficient load is kept on the dynamos at all times to keep down the speed of the water wheels. This device consists of several coils of iron wire, which are connected in shunt to the trolley circuit, and are so arranged that any current from 12 to 72 amperes may be made to flow through them. The wire is kept cool by being immersed in water, which is changed as it becomes warm. This useful device was designed by Mr. T. Ahearn.

The arrangement and facilities of the Ottawa electric railway for battling with and removing the heavy snow falls are of the most complete character. The snow is swept off the tracks by a Lewis & Fowler electric sweeper, and two Walkaway snow plows drawn by horses follow the sweeper and remove the snow bodily to the curb; a third Walkaway shoves the snow between double tracks on to the unswept track, which is immediately gone over by the electric sweeper, and in turn is followed by the Walkaways. In this manner snowfalls of nine to twelve inches have been handled in half a night throughout the whole length of the line. The snow is then shovelled into large boxes, mounted on double runners, and drawn away. A second sweeper will be in readiness in a few days. Preparations for winter were commenced as early as August. All the ordinary platform cars were converted into vestibule cars to make them comfortable for the motor men. Heavy duck canvas is fixed all around the trucks and almost reaches the rails. This prevents snow from reaching the motors and contributes to the comfort of the passengers. Special track sweepers and brooms are used on each car. The whole outfit is complete, and a more efficient service probably does not exist anywhere in America. The successful and profitable operation of a winter electric service has been so convincingly demonstrated that the influence upon other Canadian cities will no doubt be immediately felt. Much of the success of the road, especially under the severe conditions of the present winter, is due to the efforts of Superintendent J. E. Hutcheson.

The stock of the horse car line which extends from the Chaudiere Falls to Rideau Hall, is now controlled by the owners of the electric road, and it is understood to be the intention to convert this line also to electricity.

The citizens are extremely proud of the electric road, and since it went into operation the traffic has largely increased.

Mr. Ahearn is the inventor of a new form of electric heater, in form an upright cylinder, which occupies about the same space as the ordinary car stove, and will heat a car to a temperature of 70 degrees in the coldest weather. It is understood to be the intention to establish in Ottawa a manufactory for the production of these heaters and other electrical devices.

STANDARD ELECTRIC COMPANY.

THE Standard Electric Company was organized in February, 1891, with the following management: Hon. E. H. Bronson, President; C. Berkeley Powell of the firm of Perley & Pattee, General Manager; James Gibson, Secretary-Treasurer; Edward Seybold, General Agent; J. E. Brown, formerly with the Royal Electric Co., Electrician.

The Company commenced operations in February, 1891, in the old flour mill belonging to the Bronson-Weston Co., pending the erection of a new central station building especially adapted to their purposes. This was done in order to supply light and power to customers who were immediately in need of the same. The plant, which went into operation on the 1st of June, consisted of a 1500 light alternating dynamo and a 60 h. p. generator, built by the Royal Electric Co. of Montreal.

Immediately after the formation of the Company in February, workmen were set about quarrying out the wheel pit at the site of the new building. The work on the building was pushed with great vigor, the stone used being quarried on the spot. The construction is of the most substantial character, the walls being three feet thick, and the joists 12x12 inches, while the whole structure is literally "founded on a rock." The new station building was completed about the middle of August, and opened the latter part of that month.

There were placed in position two 1500 light alternating dynamos, and two 60 h. p. generators. There ha since been added to this equipment two more 1500 light machines, and two 60 h. p generators. The present capacity of the station is 6000 lights and 240 h. p.

The station is so laid out that the generators are all placed in line on one side of the building and the dynamos on the opposite side. These machines are driven from shafts on the first floor. The shafts run parallel with the building and are set on a solid stone foundation, and the foundation and stands of bearings being bolted into the solid rock, make vibration scarcely perceptible. From these shafts the belts cross each other and run to the dynamos on the second floor. Each circuit has its set of potential lines running from the centre of circuit back to potential indicator in the station. On each circuit is placed a reaction coil which keeps potential on each circuit at a uniform pressure. The switch board is a very handsome one, the switches being of white marble and polished brass. The arrangement is such that each circuit can be thrown on to any machine, and any machine on to each circuit.

The company is operating one of the largest motors in Canada, transmitting 70 h. p., and driving Messrs. Martin & Warnock's large flour mill situated a mile distant. The motor runs 24 hours per day for six days of every week, which will be admitted to be

a very severe test of its efficiency. Altogether the company are running about 180 h. p. in motors. The motors consist of 25, 15, 10, and ¼ and ⅙ h. p., the latter being used to drive fans. The line work is of a very superior character.

CHAUDIERE ELECTRIC LIGHT AND POWER COMPANY.

The accompanying illustration represents the just completed switchboard of the Chaudière Electric Light and Power Company's lighting station. The board itself, which was erected by the employeès of the company, and the instruments connected without interfering with the efficiency of the service, is built of B. C. spruce having a very pretty grain and not a sign of a knot or "shake." The instruments, ammeters, voltmeters, etc., were all made at the factory of the Westinghouse Electric Mfg. Co., of Pittsburgh, and are models of neatness and reliability. The instrument on the extreme left of the board is the "ground detector" and just below it the "ground detector switch," used every half-hour to see that the circuits are clear of all earth connections or leaks. Along the bottom of the board are the rheostats, by means of which the potential on the various circuits is regulated; next above come the bus rods, the dynamo changing switches, circuit switches, multiple-arcing and small exciter switches, then another set of bus rods. Above the top bus rods are the ammeters and voltmeters with a pilot lamp over each, the letter on the pilot lamp shade indicating the dynamo which supplies current to the instruments beneath it. At the top of the board are the lightning arresters, three different styles being shown, which marks the improvement in this line of the business, the different styles having come along from time to time with new machines. The "station converters" for working the voltmeters and pilot lamps are behind the board, as are also the "compensators," which are used to make up for the fall of potential as the load increases, and save running a potential wire from the centre of distribution. All the wiring is done from behind, the wires from the dynamos coming up through the floor, and those to the circuits going up through the ceiling to a cupola in the roof, where they branch off to their various districts.



SWITCHBOARD, CHAUDIERE ELICTRIC LIGHT AND POWER COMPANY'S STATION.

In May, 1887, the C. E. L. & P. Co., Ltd., began operations with one 250 light incandescent continuous current "United States" dynamo. The station used at that time was a small wooden structure on the Hull side of the Chaudière Falls, put up by R. Hurdman & Co., and now used by them for lighting their large saw mills.

From the first day the lights were turned on the success of the undertaking was an assured fact; orders poured in so rapidly that the officials of the company realized that they would have to go into the business on a much larger scale; accordingly arrangements were at once made with Thos. McKay & Co., proprietors of the Ottawa flour mills, and by the middle of October a three storey building about fifty feet square had been fitted up with water wheels, shafting, etc., and the company moved into its new premises. Towards the end of 1889 there were ten 250 light machines running to their full capacity every day. Up to this time store and office lighting were the only branches of the business which had received any attention, but now people began to demand the same comforts for their homes as they could enjoy at work, and house lighting commenced. For this purpose two 750 Westinghouse alternators were procured. They were rapidly filled up, and worked so well that the management of the company decided to run all their lights by means of alternators. Another building adjoining the station at McKay's was fitted up, an arch cut in the wall, and both are now filled to their utmost capacity with machines, there being eight 750 light and one 1500 Westinghouse alternators in use.

The continuous current U. S. machines which have been replaced by alternators, are used as generators for supplying current to motors, and some of them are doing excellent work in this way. The machines have been removed to a separate building a little lower down the river. The officers of the company are as follows:—President, Robt. Hurdman; Vice-President Warren Y. Soper; Secretary, Wm. Scott; Managing Director, Thos. Ahearn. The plant almost from the outset has been under the charge of Mr. John Murphy, a native of the city, who has qualified himself for the position under Mr. Ahearn's able tuition.

The company have recently purchased from Pearce & Co., their large saw mill building on the opposite side of the river, to be used as the power house of the street railway, (in which the company are also large stockholders), and for additional lighting machines. There are in place at present in connection with this building three water wheels, giving 1500 h. p., and it is possible to double this capacity. The saw mill machinery is being removed, and the electric plant will be installed as quickly as possible.

SPARKS.

It is said to be the intention of the Edison General Electric Company to put in a big plant at Duluth for lighting purposes, to be run by themselves.

The Royal Electric Co. have recently sold a 2½ h. p. motor to the Dominion Blanket Co., of Montreal, a 7½ h. p. motor to Miller Bros. & Toms, of the same city.

The Royal Electric Co. have installed a complete 500 light alternating plant at Bracebridge, Ont., and a 350 light alternating plant at Huntsville, Ont., a 350 light alternating machine at Kemptville, Ont., and a 50 light 1200 c. p. dynamo for the St. John's Electric Light Co., St. Johns, Newfoundland.

When the tubes of injectors become scaled, do not undertake to clean them with a file or scraper, as a very small enlargement of the area on the jet will interfere with the working of the instrument, but remove the tubes and place them in a solution of one part of muriatic acid to 10 to 12 parts of water. This will soften the scale, and the tube may then be washed.—*Power.*

A newly-designed pulley upon which particular attention has been paid to danger from slipping belts, has been placed on the market. On the face of the pulley at regular intervals are rubber strips with rounded surface and fastened by projections passing through the rim of the pulley. Not only do these strips do away with slipping belts, but lessen the wear on the latter and reduce the friction to the minimum. When worn out they can be replaced at a light outlay.—*Manufacturer's Gazette.*

THE ELECTRIC TRANSMISSION OF POWER.*

BY GISBERT KAPP.

LECTURE III.

(Continued from March number.)

As an example of a large modern transmission plant, I select, for illustration, that erected a few months ago for the Schaffhausen Spinning Mills. This example is not only interesting on account of its magnitude, but because it has been planted, so to say, into the very stronghold of rope transmission, namely, at the Falls of the Rhine, where the last generation of Swiss engineers carried out such admirable work in teledynamic transmission that the present generation can only copy, but cannot improve upon it. And the grand example set by Redtenbacher, Amsler, and others, on the Rhine has, as a matter of fact, been largely copied at other places. There is hardly a large engineering works in Switzerland or the South of Germany where rope transmission in some form or other will not be found, but the best days of this system are passed. Till recently, rope transmission held the field absolutely, not because it was perfect, but because there was nothing better. Now, however, we have something better in electric transmission, and the flying ropes are being replaced by the electric conductors. In the first place, the capacity of teledynamic transmission to deal with large powers is limited. During last year, the Niagara Commission inspected a large number of plants in Europe, and came to the conclusion that 330 H. P. is the very utmost which can be dealt with by a single rope, so that above this power we must employ more ropes with a corresponding complication in the gear. I need hardly say that no such limit exists in electric transmission. But there are other difficulties in connection with ropes. They wear out very fast, their support at the translating stations on the line requires the erection of very heavy and costly structures, and they are largely influenced by climatic changes, causing excessive strains at some times, and slipping at others. These considerations have induced the managers of the Schaffhausen Spinning Mills to adopt electric transmission in the very spot where rope transmission, in years gone by, has received its most perfect development possible. The situation of the works is shown on the diagram (Fig. 1). The spinning mills are on one side, and the generating station is on the other side of the river, the distance between the two being about 750 yards. In the generating station there is room for five 350 H. P. turbines, of which four are now in place, but of these only two are as yet used in connection with the electric power transmission I am about to describe. The power of these turbines is sold to the Spinning Company at the rate of £2. 16s. per annual horse power taken off the rope pulleys (Fig. 2). The turbines are horizontal wheels, and their vertical axes are geared by bevel wheels with the rope pulleys, by which motion is conveyed through cotton ropes to the two generating dynamos. The latter are six pole machines, each designed for an output of 330 amperes at 624 volts, and in regular work these machines are coupled parallel. The machines, and, in fact, the whole installation, with the exception of the hydraulic works, has been designed by Mr. Brown, to whom I am indebted for the particulars I now bring before you. The electrical part of the plant was made and erected by the Oerlikon Engineering Works. The line consists of four cables (each having an area of ·437 of a square inch), and is supported at four intermediate points, besides the supports at the terminuses. One of the intermediate supports is the old turbine house, which, in former times, was used in connection with the wire rope transmission; the others are towers of iron framework, 46ft. high, one of which is shown to a larger scale in Fig. 1. The span where the line crosses the river is 330 ft., and where it passes along the shore of the river the span is 430 feet.

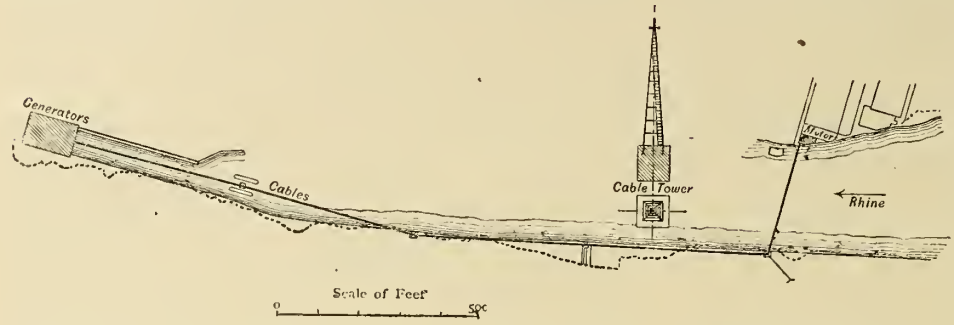


FIG. 1.

You may imagine that the proper support and insulation of cables of that size, and with so long a span, is a matter of considerable difficulty. The use of glass or earthenware insulators on a stalk, as employed for the support of telegraph lines and other light wires, is, of course, out of the question. We must have something very much more substantial, and this has been provided in the manner shown in Fig. 5. Near the top of each post there are bolted to the iron framework four of the boxes shown on this diagram—one for each line of cables. The inner box serves as a kind of junction or connecting piece between the cable ends, which are opened out, as shown. Molten zinc is then run in, and surrounds every single wire, thus making a perfect electrical joint; whilst at the same time, the strain is divided between all the wires in the most even way possible. The inner box is surrounded by an outer box, and the intervening space is cast out with sulphur, which is an excellent insulating material, and, applied in this way, of sufficient mechanical strength to resist the large forces involved in the supporting of these heavy cables.

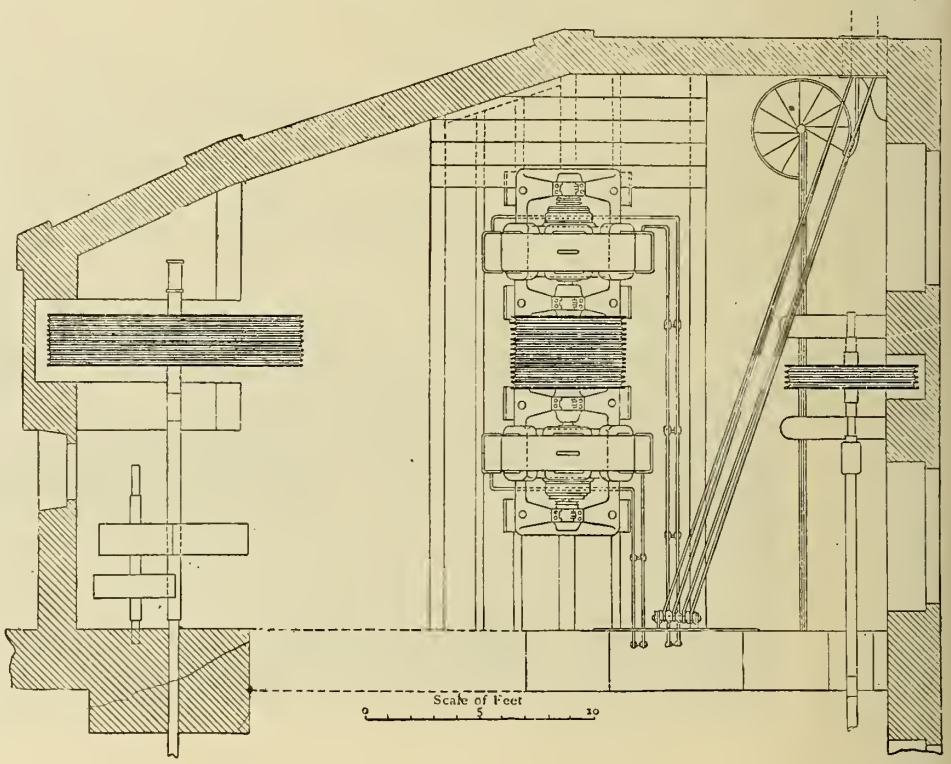
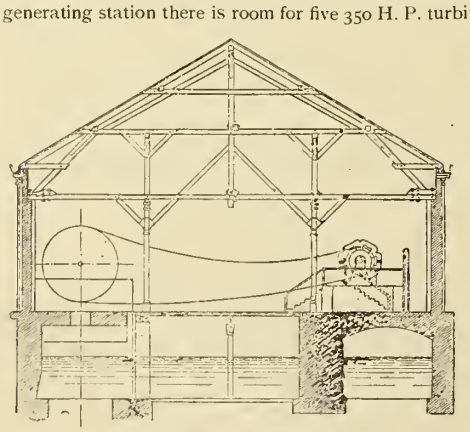


FIG. 3.



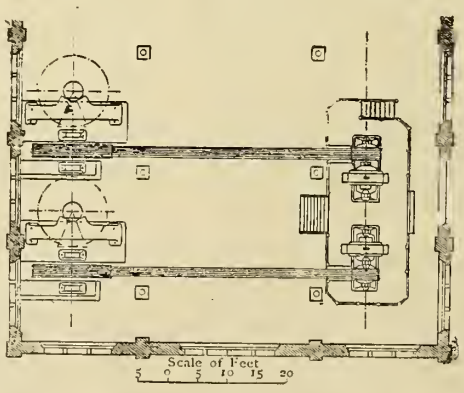


FIG. 2.

In mountainous countries, where thunderstorms are frequent and violent, the protection of lines from lightning strokes is a matter that must not be overlooked. The line I am describing is protected in a two-fold manner. In the first place, there is stretched over the four electric cables a steel wire rope, passing right over the supports, and in good electric connection with their iron framework, and therefore with earth. The object of this arrangement is to act as an ordinary lightning protector, on the supposition that a lightning flash will rather go to earth by way of the steel cable and one of the towers that run along the electric line. But lightning flashes are sometimes very erratic, as was shown experimentally is this very room, in the ad-

able "Mann Lectures," which Prof. Lodge delivered before this Society in 1888. It is, therefore, also necessary to make provision for flashes which will, for some reason or other, stray away from the direct path provided for them; and this has been done in the Schafthausen installation, by the employment of lightning arresters at both terminal stations. At each station there are four lightning arresters, one for each cable. They consist of a pair of toothed plates, of which, however, only one is fixed, the other being movable. When a flash strikes one cable only, it goes to earth by the corres-

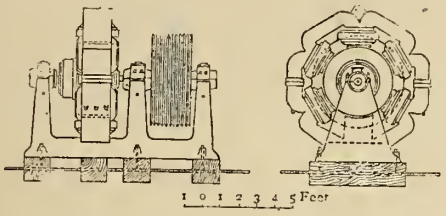


FIG. 4.

ponding plates, and no further damage is done. Should, however, both a positive and a negative be struck at the same time, then the arc set up between the plates by the passage of the lightning flash provides an easy path for the passage of the power current also; in other words, the generator will be short circuited. The object of making one of the plates movable is to cut off the short circuit current before any harm is done to the machinery. The movable plate of the lightning protector is connected to the core of a solenoid, through which the short circuit current must flow. Immediately this current is started, the core is sucked in, and the movable plate falls away from the fixed plate, thus acting the part of an automatic switch.

Returning now to the Schaffhausen plant, the generating station contains two 300 H. P. dynamos, which are over-compounded, so as to produce a constant pressure of 600 volts at the motor station, the loss in the line being with full current 24 volts. These machines have series-wound drum armatures, running at 200 revolutions per minute. Their more important electrical data, as well as those referring to the motors, are given in the table following.

Fig. 4 shows a drawing of these generators. Fig. 3 is a drawing of the twin motor, which receives the bulk of the power at the spinning mills, whilst the remainder is taken up by a couple of two-pole motors, placed in other parts of the mills. These are not shown on the diagrams, as they are of the ordinary design, with which you are already familiar. The twin motor is rated at 380, and each of the single motors at 60 H. P., making in all 500 net brake H. P. delivered to the mill shafting. The coupling between the motors and the mill shafting is by cotton ropes, as shown in Fig. 3, the arrangement chosen having the advantage that very little side strain is thrown upon the motor bearings, owing to the ropes pulling opposite ways

An interesting and novel feature of the plant is the arrangement adopted for starting gradually, and yet without the use of resistance. In my experiments last week I used current delivered at constant pressure; and, to start the motor gradually, and prevent sparking at the commutator, I was obliged to insert into the armature circuit a variable resistance, which was withdrawn after the motor had gathered enough speed to make this safe. There is no inconvenience in using such a resistance when we are dealing with small currents; but when it is a question of several hundred amperes, and the absorption of as many horse-power, the resistance becomes a very cumbersome and unwieldly appliance. To get over this difficulty, Mr. Brown has devised a very ingenious method of coupling between the line and machines, the essential features of which are shown in Fig. 6. As I have already mentioned, there are four main cables, two positive and two

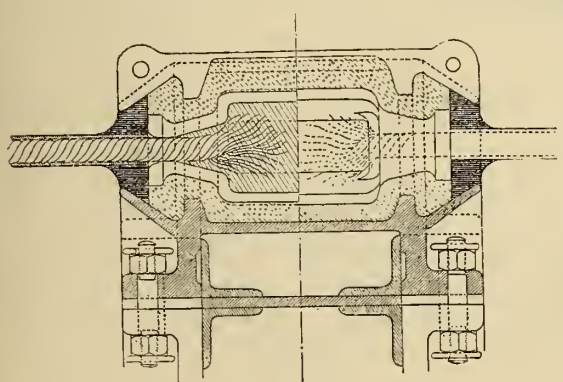


FIG. 5.

negative. Three of these cables contain no switches which need be used for starting, although of course they contain the switches and fuses which may be required for testing purposes and as safety devices, but these, not being essential to the explanation of the starting arrangements, I have not shown in the diagram. Call the two outer cables positive, and the two inner cables negative. The positive cables are looped at both terminuses, and and the inner cables are also looped in this way, but a switch is inserted in the right hand cable at the motor station. Now imagine all the machines at rest, and this switch to be open. To start the plant, the turbine-driven generator, G1, is set in motion, and the speed run up till this machine excites itself by its own shunt. If you follow the connections you will find that the shunts of the other three machines will at the same time also become excited. The motors have now made their field, and if we start the second generator, G2, slowly, a power current of gradually increasing strength will be sent through both motors, and the latter will gradually start. As they gather speed, their counter E. M. F., which is indicated by a voltmeter at the motor station, gradually rises; and if it has become equal to the E. M. F. indicated by a second voltmeter in connection with the current from the first generator, G1, the attendant closes the switch, and the operation of starting is completed. It should be noted that on closing this switch there is no sudden rush of current, since the pressure on both sides of the switch is approximately equal.

Originally the motors were intended to be pure shunt machines, but it was soon found that, owing to the very small armature resistance and armamature reaction, it was very difficult to get the load equally divided between them. Mr. Brown, to overcome this difficulty, hit upon the ingenious device of making the machines mutually control each other by putting on demagnetizing main coils, and crossing the connections between armatures and fields, so that the machine, which might at any moment develop a tendency to take more than its fair share of current, would have its field strengthened by the deficiency of current passing through its main turns to the other armature, and would thus immediately raise its counter E. M. F., and check the excess of current, whilst the other machine which was not taking enough current, would have its field weakened, and would thus be forced to take more current. It is clear that by this cross-connection even a neglect on the part of the attendant to set the brushes properly cannot materially influence the even division of current and load between the two machines. At the same time the demagnetizing influence of the main coils has the same

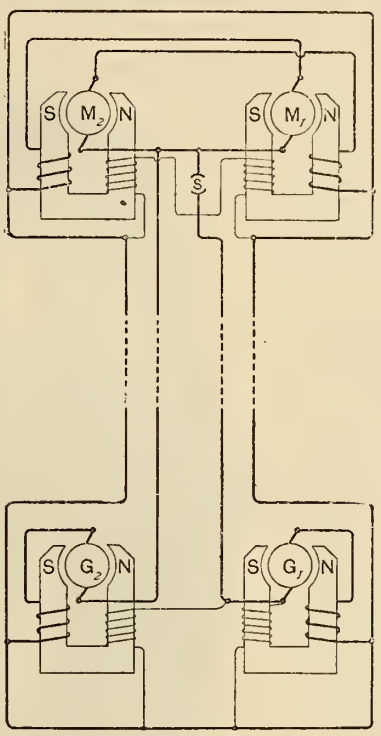


FIG. 6.

effect as if the armature reaction was increased, and insures thus constancy of speed, as I have shown you experimentally last week. In the diagram, Fig. 6, the machines are represented as if they had only two poles each. This I have done to make the diagram as simple as possible, and for the same reason I have shown the shunt and main coils on separate magnet limbs, but you will have no difficulty in translating in your own mind this principle of circuit connections to multipolar machines.

It may interest you to have a few details of a commercial nature regarding this transmission plant. The manufacturers have guaranteed a commercial efficiency at ordinary full load of 78 per cent., also that the machines must be capable of transmitting an excess of 20 per cent. over their normal power for one hour and a half without damage. The wear of one set of brushes to be not less than 2000 hours, and the life of a commutator not less than 20,000 hours. The variation of speed of the motors between running idle and under full load not to exceed three per cent. The total cost of the electrical part of the plant, including cable towers and erection, was £6,800, or £13. 12s. per net horse-power delivered.

Schaffhausen Transmission Plant.

	Generaters.	Twin motor	Small motors
Number of machines	2	1	2
Normal horse-power	300	390	60
Number of poles in magnet field	6	6	2
Revolutions per minute	300	380	350
Terminal voltage	624	600	600
Normal current amperes	330	500	81
Diameter of armature inches	47½	42½	23⅝
Length of armature core inches	20	20⅜	22½
Radial depth of armature core inches	8	7	4¾
Section of armature conductor sq. inches	·103	·078	·0287
Number of armature conductors	316	316	540
Number of commutator segments	153	153	90
Loss in armature resistance per cent	1·46	1·52	2·7
Induction in armature C.-G.-S. measure	7,500	7,600	15,800
Shunt resistance ohms	140	143	295
Loss in shunt excitation per cent	1·35	1·68	—
Main turns per magnet	6	4	
Loss in main excitation per cent	3	2	—
Type of armature	Drum.	Drum.	Cylinder

(To be Continued.)

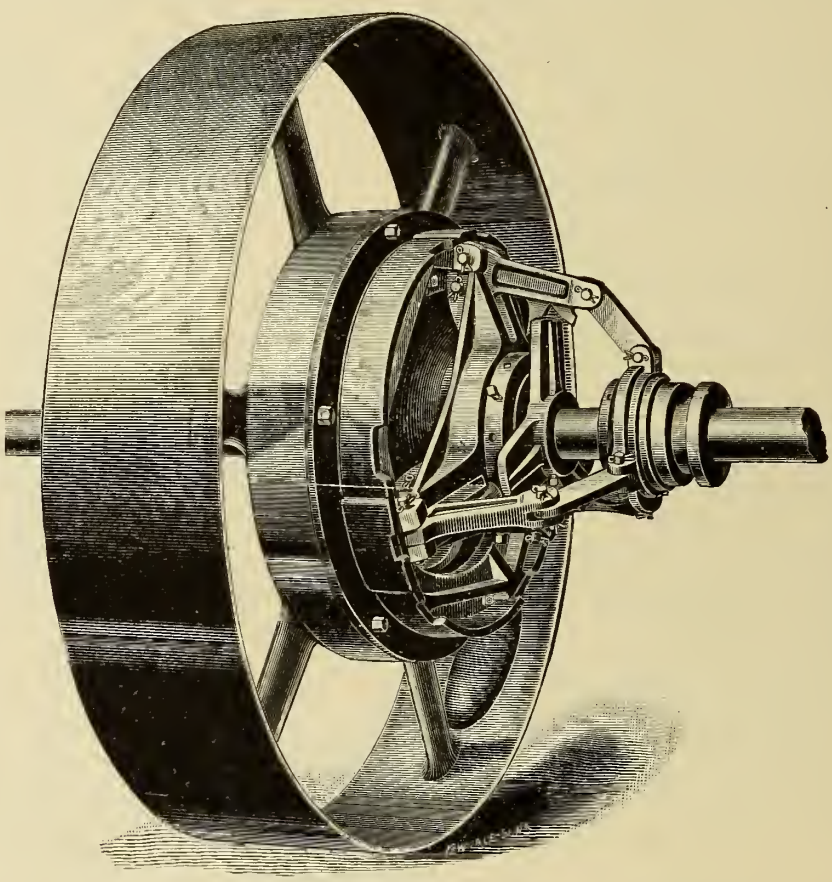
FRICTION CLUTCH PULLEY.

THE accompanying cut represents the Claussen friction clutch pulley, of which Messrs. Darling Bros., of Montreal, are the manufacturers for Canada. It is claimed to be adapted to all kinds of work, and for fast or slow speeds.

There is only one place of adjustment on the heaviest clutch, all that is necessary to make adjustment for wear is to turn a collar on the hub till the clutch holds. Arrangements are made by which the same pressure is brought on each of the three or four levers operating the pressure rings. This arrangement is permanent and not affected by the adjustment for wear. Consequently it is claimed the clutch will under all conditions drive with its whole surface, each square inch of which will do an equal share of the work transmitted.

The surfaces of the clutch are large, consisting of two continuous rings, clamping a third ring by means of levers and toggle joints. When the clutch is thrown out of action the clamping rings draw out of contact with the driven ring simultaneously, thus preventing rubbing and wear and clearing the driven ring 3-16 to ¼ inch on each side when completely thrown out.

On an ordinary sized clutch, the driver consists of 32 pieces, including all screws and pins. On the larger sizes, the number of parts would be 38. This clutch is made of good material and workmanship. The levers and pins are of steel.



CLAUSSEN FRICTION CLUTCH PULLEY.

COMPLIMENTARY DINNER.

Messrs. A. M. Wickens, President, and A. E. Edkins, Secretary of the Executive Board of the C. A. S. E., while on a visit to Montreal recently, were tendered a complimentary dinner at the Richelieu Hotel by some of the older members of Montreal Branch No. 1. Among the persons present were Mr. Fred. Thomson, of the Royal Electric Co., Capt. Wright, M. E., Mr. Garner, of the Nordberg Governor Co., Mr. Clarke, P. C. E., of the Locomotive Brotherhood; the Presidents of Montreal No. 1 and of St. Laurent No. 2. The duties of chairman were happily discharged by P. President Hunt, the vice-chair being occupied by president T. Naden. The *menu* was of a most satisfactory character. After the toast to the Queen had been loyally drunk, Messrs. Garner and Nutall responded on behalf of "The Manufacturers," Mr. Thomson for "Electricity," Capt. Wright for "Education," Messrs. Clarke and Acton for "The Locomotive Brotherhood," and Messrs. Wickens and Edkins for "The C. A. S. E." Some excellent songs contributed much to the enjoyment of an unusually enjoyable occasion. A vote of thanks was passed to Messrs. Ryan and Robertson, and the gathering dispersed after singing Auld Lang Syne and the National Anthem.

Mr. Warwick, who was engaged to superintend the operation of the new electric plant for the town of Toronto Junction, has resigned and gone to England to fill a position with the Chelsea Electric Light Co., of London.

Mr. Chas. J. Van Depoele, well-known veteran electrician, died at Lynn, Mass., on March 19th. It will be remembered that Mr. Van Depoele's ideas and assistance were employed in first putting into operation the electric railway in connection with the Toronto Industrial Exhibition. In 1888 the Van Depoele company sold out its electric railway system to the Thomson-Houston Electric Co., of Boston, whose services Mr. Van Depoele entered as electrician.

QUESTIONS AND ANSWERS.

A correspondent writes:—"Will you kindly give the rule for finding the bursting strain of a cast iron cylinder, also give factor of safety, or rule for commuting the safe working pressure, and please state if rule is used by English Board of Trade or not."

We do not know if the English Board of Trade has any rule for this purpose or not. The strength of a cylinder made of cast iron may be calculated by same formula as is used in calculating the strength of a cylindrical steam boiler, if the thickness of metal in the cylinder be small compared with the diameter.

The bursting pressure is found by multiplying the thickness of the cylinder by the tenacity of the metal, and divided by the radius, or half diameter of the cylinder.

Let p = the pressure in pounds per sq. inch.

Let f = tenacity of the metal in pounds per sq. inch.

Let t = thickness of cylinder in inches, or fractions of an inch.

Let r = half diameter of cylinder in inches.

Thus: $$p = \frac{ft}{r} = \text{bursting pressure.}$$

Cast iron is a metal very variable in quality, so far as tensile strength is concerned; hence, while the formula is strictly accurate, there may be great difficulty in determining the true value of f.

A number of experiments were made at Woolwich dock yard some years ago, and of 850 samples, the tensile strength ranged from 9.417 pounds to 34.279 pounds per sq. inch.

The tensile strength of cast iron is often taken as being 18,000 lbs., which is nearly double what the weakest of the Woolwich specimens showed, and a little more than one-half the strength of the best of the specimens. This uncertainty as to the actual strength of the metal has lead to the custom of using 18,000 pounds or thereabouts as the value of f in the formula, and then using a factor of safety of 10. To calculate the safe pressure use the same formula as for the bursting pressure, but let $f = 1800$ pounds per sq. inch. If our correspondent means by a cast iron cylinder, the cylinder of a steam engine, something more is required than merely to determine the bursting pressure or the safe working pressure. A safe way to calculate the strength of a cylinder for steam engine is to use the formula given for safe pressure, and determine the thickness of metal and then add about ½ inch for boring or reboring. The formula altered to give the thickness of metal required for a given pressure and diameter would be

$$t = \frac{r\,p}{f}$$

and with allowance for boring or re-boring

$$t = \frac{r\,p}{f} + 5 \text{ in.}$$

A cylinder 20 inches diameter to carry a steam pressure of 150 pounds should by this rule be:

$$t = \frac{10 \times 150}{180} + .5 = 5\text{-}6 + 3\text{-}6 = 1\ 1\tfrac{1}{3} \text{ inch}$$

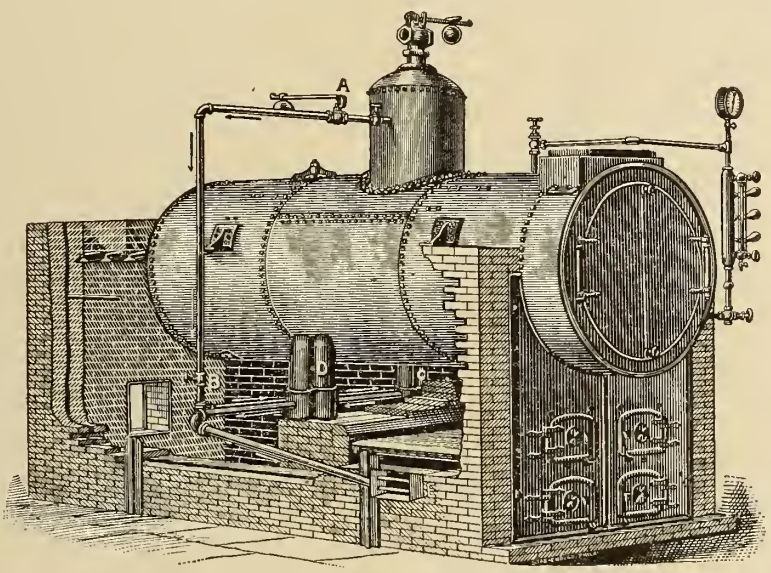
thick, which would be considered good practice, unless the cylinder be so placed that other strains come upon it in the working of the engine.

THE IMPROVED METHOD OF HEATING.

THE Cornell-Goode device for improving the combustion in furnaces is illustrated by the accompanying engraving. It operates as follows:—A small quantity of steam is made to pass through cast iron retorts which are placed in the combustion chamber of the furnace, where they are heated constantly and uniformly to a cherry-red. Here, by means of heat, the steam is dissociated into its elementary gases, hydrogen and oxygen. The product from the retorts passes through an air injector, and carries the air necessary for the combustion of the coal into the enclosed ash-pit. The oxygen unites with the carbon in the fuel, forming carbonic oxide gas, which with the hydrogen and air rises through the fire and burns around the boiler, forming carbonic acid gas and water vapor. These actions produce a condition in the furnace most favorable to the complete combustion of the coal fuel, and hence the economy.

Perfection of combustion is not the only advantage claimed for this system. With the use of either anthracite or bituminous coal, long flames of burning gases are produced which envelop the boiler, equalizing the work done throughout the entire heating surface, thereby rendering the surface more efficient, and avoiding unequal expansions and contractions of the plates. This prolongs the life of the boiler and boiler setting. The heat is so uniformly distributed throughout the boiler that there is no liability of the water being lifted off in sheets. The device is equally well adapted to a boiler which develops less than the rated horse power.

With natural draught a very large percentage of air in excess of that required or utilized by the fuel is supplied, so that large volumes of air are heated and wasted at the expense of the coal. It is claimed that this system supplies only the air requisite for combustion and so distributes this air that is made available, and that this reduces the chimney temperature to but little above that of the steam in the boiler; and further, no clinker is formed whatever the grade or kind of coal used, hence the work of firing is decreased, and the life of the grate bars and furnace walls is prolonged.



THE CORNELL-GOODE DEVICE.

The Cornell-Goode device can be attached to boilers using a small quantity of coal, or those burning 1,000 pounds or more of coal per hour in each boiler.

The Thermolytic Fuel Co., of Napanee, Ont., are the Canadian manufacturers of this device, and will be pleased to supply full information concerning it.

FIRE IN THE G. N. W. TELEGRAPH OFFICES AT MONTREAL.

SOME of the liveliest work that has ever been done by the operators of the G. N. W. Telegraph Co. was accomplished in the Montreal offices on the night of March 8th, in connection with the Quebec elections. The returns from a district 800 miles in extent were collected and given out by ten o'clock. At the conclusion of five hours of unusually hard work, many of the operators went home, while others remained to send out special reports to the press. The attention of the night manager, Mr. W. B. Rivet, was called shortly after twelve o'clock to a jet of smoke issuing from between two sub-sections of the Company's big switch-board, into which ran over 100 wires. Seizing a hand grenade, Mr. Rivet attempted to smother the flames, but without avail. An alarm was sent in to the fire department and when the firemen arrived, the fire, running along the oil-soaked covering of the office wire, had reached the ceiling, where covered by the plaster it was extremely difficult to deal with. There was some delay in getting the hose up the winding-stairways to the operating room, but a good pressure was obtained and after an hour's hard fight, during which time the ceiling was torn down, the fire was got under control. The connections from the switch-board to the operating tables were ruined, the floor piled with *debris*, and the two lower flats of the building flooded with water. It was thought at one time that all the valuable apparatus and batteries of the Company would be destroyed, but fortunately these were saved.

The fire was caused by an electric wire falling across the company's line on St. Gabriel street. The loss is estimated at $5,000.

The operators stuck to their instruments as long as it was possible for them to do so. One of them who was sending to Toronto advised the operator there that the building was on fire and that when he could get no further response he would know that the wire had given out. Shortly after communication was suspended, and the Toronto man concluded that for once the expected had happened.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

Editor ELECTRICAL NEWS.

At the last regular meeting of the Toronto Branch, held March 11th., arrangements were completed for the purchase of an indicator and planimeter, for the use and instruction of the members, at a cost of nearly one hundred dollars. A committee of seven was appointed to take charge of the instruments, and to instruct any of the members who wish their services, and loan out the instruments under the following rules:

Rule 1.— Application must be made in writing to the chairman of Indicator Committee, who will number the application and give the use of the indicator accordingly.

Rule 2.—Any Brother not in good standing in the association will not be allowed the use of the indicator.

Rule 3.--The instrument must not be kept longer than 72 hours, under a penalty of 25c. per day for every day so kept.

Rule 4.—Any Bro. breaking the indicator must pay 25% of of the cost of repairing, except it be a spring, in which case he is exempt from any charge.

Rule 5.—Each Bro. using the indicator must leave a pair of cards from his engine with the drawings to be filed and kept for discussion by the Association.

Rule 6.—No Bro. shall obtain the use of the indicator to indicate any engine other than the one he has charge of.

Rule 7.—Any Bro. in need of the indicator, on account of a break-down, or by reason of taking charge of another's plant, may have precedence of other applications by paying 25c. per day. A book on the indicator and steam engine practice is also to go with the indicator for the benefit and instruction of the members.

I think this is a grand step in the right direction. These instruments are costly, and above the individual reach of many of us, and very few of the employers can be made to understand that it will pay them to buy them for our use. Hundreds, and I may add thousands of dollars have been saved in the coal pile in one year by the use of the indicator, as the valves of an engine cannot be properly set without it. Employers will notice that we are not working only for ourselves, but that we hope in this way to pull down the coal bill. I should like to see many more of the engineers of Toronto join us. The knowledge of the use of the indicator alone is worth far more than the initiation fee of $3.00, not to speak of our lectures and discussions on steam engineering.

Yours truly,

G. C. MOORING,
Chairman Committee.

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ADVERTISEMENTS.

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EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

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MONTREAL BRANCH NO. 2.—Meets 1st and 3rd Tuesday each month, in Mechanics' Institute, 204 St. James street. Matthias Guimond, President; Alfred Latour, Secretary, 801 Albert street, St. Henri.

THE Canadian Association of Marine Engineers is asking for legislation to compel foreign engineers seeking employment in Canada to undergo examination as to their proficiency. The Association has also petitioned the Minister of Marine to make it compulsory upon engineers to exhibit their certificates in their engine rooms.

WE know of an opening in British Columbia for a first-class engineer, with the knowledge necessary to enable him to properly look after two dynamos and other electric apparatus. A year's engagement is required. If any of our readers feel themselves to be competent to fulfil the duties and would like to obtain the position, they may obtain further particulars at the office of this paper.

NOTICE of motion has been given in the Dominion Parliament of the proposed introduction of a Bill to compel the placing of all electric wires underground. Managers of electric companies should at once impress upon their local representatives in the Dominion Parliament the necessity of assisting to defeat a measure which would work ruin to a large number of the electrical industries of the country.

"Engineer wanted, one with knowledge of electricity preferred, to run large stationary engine, must be well recommended"

THE above advertisement clipped from a Toronto daily paper, may be regarded by engineers as one of the straws showing in which direction the wind is blowing. As time passes, engineers possessing a knowledge of electricity will not only be "preferred," but for the most important positions such knowledge will be regarded as an indispensible qualification. Those engineers who may not thus far have applied themselves to an understanding of electrical principles, should lose no time in doing so.

IN these days when electricity is being pictured as a destroyer of life, it is refreshing to come across a person who has faith in its life giving or life preserving qualities. The writer had a conversation with such a man a few days ago. He was wearing on his wrist and ankle a couple of turns of copper wire as a preventative against rheumatism. Without professing to know its mode of action, he cites the case of a friend who was so crippled by rheumatism as to be powerless to move his limbs, but who, by wearing copper wire in the manner described, was entirely freed from the disease. Perhaps some of our electrical experts will be able to explain this phenomena.

NOT long ago the steam pressure failed in a boiler which had been working well for some years. The boiler was stopped and opened up for examination. A great mass of greasy deposit was found inside, and it was estimated that a scum of about two inches thick of grease had been floating on the top of the water and had interfered with the steaming of the boiler. Had much of the stuff got fast on the plates exposed to the heat of the fire, there would soon have been only fragments of a boiler left. The engineer is to be congratulated on having had sense enough to open the boiler to look for the missing steam. Oil is a very good thing in its right place, but inside of a steam boiler is not the right place.

WE print a communication referring to the fact that the Toronto Branch of the C. A. S. E. have expended nearly one hundred dollars in the purchase of an indicator and planimeter for the use and instruction of the members. Such a tangible effort to improve the status of its members reflects the greatest credit on the Association, and presents in the clearest possible light, the praiseworthy objects which it is seeking to promote. We heartily second the hope expressed in our correspondent's letter that many engineers at present outside of the association will see the desirability of connecting themselves with it. Employers should also give it their encouragement and support, inasmuch as the organization is one which will result to their advantage.

HOW long should a steam engine last? That is a question more easily asked than answered. As the durability of the engine depends first on its construction, and then on the care taken of it. Engineers ought to take a pride in keeping their engines bright and clean. Owners should not grudge whatever is needed in order that this may be done, as it prolongs the life and good work of the engine. An engineer who can feel com-

fortable and at home in a dirty engine room, looking at a greasy rattler throwing the oil around, we hope will soon be an extinct variety of the engineer genus—at least in this country. Some engines get used up in a few months, but we lately saw one working very smoothly which was made in Glasgow in 1840 and has been in use ever since. It was a credit both to the builders and to the men who have had charge of it.

THE Hamilton street railway franchise has been secured by the old company, and steps will at once be taken to substitute electricity for horses. The people of Hamilton have sensibly become convinced that the trolley system is the only one which is at present practicable. In Toronto the opposite course is being pursued by a section of the City Council. The opinions of aldermen whose knowledge of the subject is of the most meagre description seem to carry greater weight than the recommendations of the City Engineer, the opinions of electrical experts and the results of all the experimenting that has been done by American cities. The outlook at present points to the decision regarding the system to be adopted being delayed to an extent which will give the Street Railway Company good grounds for damages against the corporation.

A BRITISH Columbia correspondent, who is interested in a large deposit of first-class mica, enquires of the ELECTRICAL NEWS what the prevailing prices are in Ontario. He states that he would prefer to sell here rather than in the States. We have pointed out to our correspondent the fact, which may have interest for other readers as well, that large deposits of mica exist in Ontario, and that during the last year or two many hundreds of tons have been mined, much having been sold to the Thomson-Houston Co., of Boston. The Canadian demand is as yet small, although steadily increasing, owing to the fact that the material is constantly being applied to new uses in connection with the electrical business. Taking into consideration, however, the limited demand and the abundance of the material to be had in this province, it seems altogether improbable that mica could be shipped here from British Columbia and sold to advantage.

THE operation of an electric railway and three electric light companies makes the successful working of the telephone a matter of extreme difficulty in Ottawa. The induction on the Bell Company's long distance grounded lines made them practically useless either day or night and the business fell off to a mere fraction of its former volume. To remedy the trouble the company's assistant manager, Mr. E. C. Dewar, has adopted the following device. Between the central office and the outskirts of the town a metallic circuit was strung and connected to one coil of a transformer placed under shelter on a pole ; to the other coil was connected the long distance line and a line to the earth. The result is most satisfactory—all noise from power and light currents having disappeared. Some difficulty was at first experienced in ringing through the coil, but by speeding up a power generator and ringing on both sides of the metallic circuit, signals can be sent to any office on the line. The resistance of each coil in the transformer is, of course, the same, about 67 ohms.

AT the last meeting of the Executive Committee of the Canadian Electrical Association, there were handed in twenty-two applications for membership. This must be considered very satisfactory progress. The more the possibilities of the Association are considered, the more apparent it becomes, that if properly supported and conducted, it will prove a decided benefit to the various departments of electrical business. The Executive Committee are discharging their duties with commendable energy and faithfulness, a proof of which is to be seen in their readiness to come long distances to attend the business meetings in Toronto. Arrangements for the first annual convention in June are rapidly assuming definite and satisfactory shape, and there is good reason to anticipate that the event will prove one of much interest and profit. Every person interested in electrical matters in Canada, would find it an advantage to become a member of the Association and assist in making it of the greatest benefit in the diffusion of electrical knowledge, and in guarding and promoting electrical interests.

ON the 12th March a large fly wheel in the electric light station at Cincinnati is reported to have burst when making 73 revolutions per minute, and to have caused damage to the extent of $20,000. From the accounts published the wheel was 24 feet in diameter, and at 73 revolutions the rim would move with a velocity a little over one mile per minute. The frequent bursting of fly wheels of cast iron should lead engine builders to be more careful in the construction. The tensile strength of cast iron is a very uncertain quality, and as wheels are often made, the internal strains, produced while the metal is cooling, frequently strain the arms almost to the point of rupture. The rim and the arms should be cast separately, and the wheel carefully built and well fitted and exactly balanced. In these days of steel, the arms might be of steel, or else have no arms at all, but use discs of steel boiler plate to connect the central hub with the outer rim. The outer rim and the central hub might be of good cast iron, and the discs could be rivetted to them.

THE daily press of the United States and Canada has been largely instrumental in imbuing the public mind with an exaggerated idea of the dangers attending the use of overhead electric wires. We were consequently pleased to see it announced that the annual convention of the Canadian Press Association would be held this year in Ottawa, being satisfied that an opportunity of seeing an electric railway in actual operation by the trolley system would give the members a more practical acquaintance with the subject and serve to correct some of their erroneous ideas. We had the satisfaction of hearing one member of the Association remark on the day following his arrival, that he was suffering from a great disappointment. He had always understood that where electric railways were operated by overhead wires it was quite a common occurence to see persons fall dead on the street. After having spent a day in the city he had not witnessed a single death as the result of the "deadly" overhead wire. Judging by what is appearing in the daily papers of Toronto at present, it would seem that Toronto journalists did not attend the convention, and also that they have not as yet had any other opportunity to meet with the same disappointment as that of the member referred to.

THERE is considerable agitation in some of the largest cities in Ontario at the present time over the probable adoption of the trolley system for the operation of their street railways. Advocates of the storage battery system are using every effort in their power to keep up the cry of "away with the trolley," but there can be no two opinions among those who know the results of the tests and trials of the different methods of street propulsion, as to which is the superior system. While cars have been operated, and are being operated at the present day by storage batteries, yet it is at a great loss in profits in comparison with those that are being operated by the trolley system. True it is, that so far as the appearance of the streets is concerned the storage battery has the advantage, but when it is considered that a storage battery car is apt at any minute to become stalled—when perhaps miles from the station—through a sudden and unexpected giving out of some of the plates, necessitating the sending of a team of horses to haul it into the car house, it will be plain to everybody that the trolley has the advantage, for as long as the current is supplied the trolley will take off its quota and fulfil its requirements at all times. An armature may burn out, but so it will with either system, provided the construction is poor. The only argument then against the trolley is its unsightliness, but in this age of push, sightliness is of secondary consequence to utility; the primary object is to get where one wants to go at a more rapid rate than by means of horse power. While we are emphatic in our statement that at this time there is nothing in existence to equal the trolley, yet we are just as emphatic in saying that there is a time coming when the storage battery will be so improved that it will be an unqualified success, and when that time shall have arrived the trolley will have to go. It therefore behooves corporations and others who have railway deals on hand at present, to make their agreements with the railway companies in such a way that they will be compelled to change to the more improved method just as soon as it is a success in every way. In the meantime the should adopt the trolley, and retire the overworked quadrupeds who are doing duty

as street car motors, much to the disgust of a large majority of people who are compelled to use the street cars to cover the distance between their homes and places of business.

THERE is perhaps no better method by which electric lighting companies may increase their revenue than to supply power by means of electricity distributed in small parcels over a considerable area of territory, and we feel it our duty to point out to the managers and directors of such companies the benefit that will be derived from branching out in this direction, being sure that the receipt in power rentals will in all cases fully compensate them for their first outlay in plant. This applies principally to cities of from ten to fifteen thousand inhabitants and upwards. Not only is the steam producing plant worked more economically, but it reduces the cost of maintaining the electric light plant also, on account of the same help, (such as linemen, dynamo cleaners and attendants) being able to take their part in the construction and maintenance of the power lines and plant generally. There are to-day few cities in Canada of the size spoken of, in which at least 100 horse power could not be installed in small motors ranging in size from ¼ h. p. to about 10 h. p. It may not be generally known, but it is a fact nevertheless, that with a 50 h. p. generator installed, at least 100 h. p. can be sold on the circuits. From data obtained in cities on the other side of the line where motors are being operated by electric lighting plants, it is learned that the use of such motors averages about one-third of their rated capacity, so that really three times the capacity of the generator could be sold on the lines were it necessary to do so, but a safe and practical margin to work on is an overload of 100 per cent., or just double that of the generator, as this 100 h. p. should turn in a revenue, running 10 hours a day, of not less than $60 per horse power in small motors, it will be readily seen that a revenue of $6000 a year from such source will not only pay a big interest on the investment, but will add materially to the shareholders' profits. A first-class plant, such as here mentioned, should be installed for a sum not greater than $10,000, probably less. Of course, in supplying such power, it is best to make a graded price per year according to the size of the motor installed, a fair rate for which, practice teaches us, is about as follows:—¼ h. p. per year $30.00; ½ h. p. per year, $50.00; ¾ h. p. per year, $70.00; 1 h. p. per year $90.00; 1½ h. p. per year $130.00; 2 h. p. per year $140.00; 3 h. p. per year $195.00; 4 h.p. per year, $250.00; 5 h.p. per year, $300.00; 6 h.p. per year $350.00; 7½ h.p. per year, $400.00; 10 h.p. per year $500.00, and so on, beyond which size a stated amount per h. p. can be charged. There are very few cases in which, if these prices prevail, the motive power necessary to run an ordinary shop cannot be supplied for at least 25 per cent. less than the parties can run their own power by means of steam engines. Another suggestion in this connection here crops up, which is, that a shop or factory of any kind, supposed to be using from 15 to 20 h. p. with their steam engine, can be operated successfully in every case with not more than a 10 h. p. electric motor, for such is the elasticity of a good motor that it will carry a temporary overload of from 25 to 50 per cent. according to the conditions. There are few factories to-day using a 15 to 20 h. p. steam engine, whose actual requirements average more than three-quarters or one-half of that amount, and it is only an occasional and very rare occurrence when their actual need ever goes beyond 10 horse power, and then only for a very short period, at which time the motor will be found able to "get there." All things considered, we feel that we are offering the best possible advice when we say, by all means install a power plant, and work it in conjunction with your electric light plant at once. Do not hang back; it is bound to pay a big return for your investment in every case, besides giving a status to your company that it cannot otherwise possess.

THE use of friction clutch pulleys in modern electric light and power stations is undoubtedly a move in the right direction, for by their use it is possible for the dynamo attendant to handle his apparatus in the manner most convenient for the good operating of the plant; but it behooves the parties who are contemplating the use of such pulleys to not only look well into their requirements in that direction before purchasing, but also to see that they get the most suitable for their purpose. As usual in such cases, there are "clutches and clutches," some of them entirely inadequate for the purposes they are frequently sold for. This article is not meant to condemn any particular make of clutch pulley, but simply to point out to contemplating purchasers what is necessary and what is not necessary in a clutch pulley for use in a dynamo station. It must run steady without any wobble; it must be perfectly balanced; it must be as light as possible, consistent with good and strong construction; it must be able to stand on a running shaft for 20 or 25 hours or more without dangerous heating in its bearings; it must be capable of being thrown off or on without the exertion of a large amount of muscular power; it must be capable also of being thrown in, and kept running for a week or more without being thrown out again, but when thrown out must run idle on the shafting as before; it must be so made that it will carry an overload of at least 100 per cent., so that in case of a temporary short circuiting of a dynamo it will be able to bear the strain of the temporary overload, and last of all, it must be such a clutch that if there is any slipping of a grip or grips and it is necessary to stop the pulley so that they can be set again, it can be done without having to stop the engine and perhaps several other pulleys on the same line of shafting operating dynamos to adjust this one—in other words, it should be such a clutch pulley that when it is necessary to stop the pulley the clutch comes to rest at the same time. This will be found on consideration to be a most important point in the selection of a clutch pulley for the running of a dynamo, particularly if, as has been pointed out before, there are more than one running from one line of shafting and one engine. Another important feature that should be well looked into, is the ability of the pulley to lubricate its bearing in a thorough manner when at rest, avoiding thereby the destructive heating effect caused by poor lubrication and the consequent melting of the babbited sleeve bushing. As to the matter of cost, we may say that when it is taken into consideration that to stop any one or more dynamos on a line shafting without shutting down the engine it is necessary to have either a loose pulley or belt holder of some kind, whereas with the clutch there is none required, it will be plainly evident that when an ordinary cast iron pulley is bought at a certain price, and the additional cost of a loose pulley or idler is added to it, there is very little difference in the price, and that difference is more than compensated for by the fact that there is no wear or tear on the belts, as there undoubtedly is with any shifting device, no matter how well made it may be. We feel positive in making the assertion that the life of a belt thrown on to idlers every day is shortened by fully 25 per cent. There is no intention of recommending anybody's make of friction clutch pulleys, nor is there any intention of treading on any of the numerous makers' toes, but this much we can say, that we know that there are some clutch pulleys made (and in Canada, too,) which fill the bill to perfection; and if this article shall be the means of inducing but one manufacturer of clutch pulleys, whose pulleys do not come up to the requirements, to make them conform to it in every particular, or if it shall be the means of proving beyond a doubt to at least one central station manager that the clutch pulley is a necessary piece of machinery in his station, we shall feel that its mission has been more than filled to our satisfaction.

ELECTRICAL CONSOLIDATION.

A CONSOLIDATION of the electrical interests in the city of St. John, New Brunswick, has been effected by the organization of a new company known as the Consolidated Electric Company, Limited, which has taken over the Eastern Electric Company, Limited, the New Brunswick Electric Company, Limited, and the St. John City Railway Company, and thus becomes one of the largest companies in Canada. The officers are: John F. Zebley, of New York, president; H. B. Zebley, of New York, secretary-treasurer; Chas. D. Jones, of St. John, manager, backed by a strong board of directors composed of New York and St. John gentlemen.

The Peterboro Electric Light and Power Co., have purchased from the Royal Electric Co., a 40 light arc dynamo.

Mr. Robt. McGowan, the owner of the Ball electric light plant at Durham, Ont., has purchased from the Ball Co., the 50 arc plant at Oakville, Ont., where a contract has been made for 20 arc lights at 15 cents per night. The lights are said to be giving satisfaction, and it is expected that their number can be doubled.

CANADIAN ELECTRICAL ASSOCIATION.

A MEETING of the Executive Committee of the above Association was held in Toronto on March the 16th. The following members were present :—Messrs. J. J. Wright, in the chair ; K. J. Dunstan, John Carroll, S. J. Parker, H. O. Fisk, D. Thomson, T. H. Wadland, John Yule, W. A. Johnston and the Secretary.

Messrs. Thomson and Wadland reported that the Hamilton Electric Light Co.'s old premises could be had for exhibition purposes in connection with the annual meeting.

The Secretary was directed to write to Canadian electrical manufacturers requesting to know whether they would be willing to send exhibits to Hamilton.

It was resolved that circulars be printed in accordance with the draft prepared by the sub-committee appointed at last meeting, setting forth the objects of the Association, and sent to all persons supposed to be interested.

The following persons were elected to active membership in the Association :—Hugh Neilson, Jas. A. Baylis, Bell Telephone Co.; Frederic Nicholls, manager Toronto Incandescent Electric Light Co., Toronto ; W. J. Morrison, Cobourg Electric Light Co., Toronto ; A. Stevenson, manager Peterboro' Light and Power Co.; J. H. Greer, Peterboro' Light and Power Co., Peterboro', Ont.; W. B. Shaw, electrician, Montreal ; F. B. Allen, Reliance Mfg. Co., Waterford, Ont.; George Wilkes, Brantford Electric Light Co., Brantford, Ont.; L. B. McFarlane, Bell Telephone Co., Montreal.

The following persons were elected as Associate members : Robt. T. Dickinson, Electric Light and Power Co., Hamilton ; J. A. Doucett and W. A. Tower, Bell Telephone Co., Toronto ; Alex. Taylor, Edmonton, N. W. T.; J. E. Saucier, manager Electric Light Co., Kamloops, B. C.; Wm. Bourne, Edward Bourne, Toronto Electric Light Co., Toronto.

A number of applications for membership were handed in at the close of the meeting, which will be considered at next meeting of the Committee.

PORT ARTHUR ELECTRIC RAILWAY.

The new electric railway at Port Arthur, Ont., was put in operation about ten days ago, unde the direction of Messrs. Barr and Peterson of the Edison General Electric Co., who were the contractors. The road connects the town of Port Arthur with the town of Fort William, and traverses a distance of three and three-quarter miles.

The trial trip is pronounced to have been a most successful one. A distance of three miles was covered in 12 minutes, and the movement of the cars is said to have been so steady and easy as to delight the onlookers. The cars, which were manufactured by Messrs. Patterson & Corbin, of St. Catharines, Ont., are 18 feet in length, inside measurement, and finished in hard wood. Under the seats are placed Burton heaters. There are seven plate glass windows at either side of the car, while in the dome there is a group of three electric lamps. The front and rear ends are supplied with electric lamps, backed by powerful reflectors. The cars can be stopped within a space of ten feet. Each truck is equipped with two 20 horse power motors. The metal finishings, hand rails and ornaments are highly burnished brass, the outsides of the coaches is painted in royal red, sea green and other colors, with gold monograms, the whole combining beauty with strength and utility. The power house is 50 x 50 feet, with engine room in addition. It is situated at the mouth of the Current river and fifteen feet from the water's edge, so that steamships can discharge coal into the boiler room. The engine, dynamos, shafting and immense fly wheel, weighing eleven tons, are supported by massive stone and cement piers. The engine is a Wheelock, with a capacity of 150 h. p., manufactured by Messrs Goldie & McCulloch, of Galt. It is the intention to utilize the great water power which hitherto has served no useful purpose, and to transmit power to the manufacturing industries of the towns. A temporary structure in the centre of Port Arthur is at present being utilized as a car house. There is telephone communication between the office and power house, the car house and the station at the Fort William terminus. Connected with the car house there is a well equipped repair shop.

The Standard Electric Co., of Ottawa, have just added to their plant a 25 h. p. motor manufactured by the Royal Electric Co., of Montreal.

LUBRICATING OILS.

THE question of lubricating oils is an important one to all managers of electric generating stations, and there exists considerable difference of opinion as to which oil gives the best satisfaction in practical use. Naturally most makers of oils claim that their own is superior to any others, and there is unquestionably some grounds for these claims, as many of the oils are of superior merit.

During the Convention of the National Electric Light Association in Buffalo last month, Mr. F. A. Lane, of Cleveland, Ohio, made a few remarks at one of the meetings on the subject of lubricating oils, which were of interest. He said that most people were under the impression that it was necessary to use lubricating oils of high viscosity and low gravity in order to get good lubrication on heavy or high-speed machinery. He said that after extended experiments it had been found that a light oil, light in gravity and low in viscosity, was the oil that would give the best satisfaction in the lubrication of both high-speed and heavy machinery. In the case of machinery running at very high speed an increase of oil will increase the temperature ; and unless oil enough to absorb the heat is used, so that the oil will run away, taking the heat with it, the heat cannot be reduced by a large amount of oil. Mr. Lane recommended an oil of about 32° gravity and 140° viscosity. He instanced the Calumet and Hecla mines, where lard oil was used up to two years ago, but now a mineral oil is used. Objection was sometimes raised to oils because they produced a gummy substance ; but this is usually a scale-making material, which comes from the walls of the cylinder. As a rule, any oil that will produce a gummy substance is a good oil.

STANDARD MATERIALS ADOPTED BY THE AMERICAN BOILER MAKERS' ASSOCIATION.

CAST IRON.—Should be of soft, gray texture and high degree of ductility. To be used only for hand-hole plates, crabs, yokes, etc., and manheads. It is a dangerous metal to be used in mud drums, legs, necks, headers, manhole rings, or any part of a boiler subject to tensile strains : its use should be prohibited from such parts.

STEEL.—Homogeneous steel made by the open hearth or crucible process, and having following qualities, is recommended for use in all boilers, and shall receive the endorsement of this association by means of the protected stamp of the association :

Tensile Strength.—55,000 to 65,000 lbs. per square inch.

Elongation.—20 per cent. for plates ⅜-inch thick, or less ; 22 per cent. for plates from ⅜ to ¾-inch thick ; 25 per cent. for plates over ¾-inch thick.

Test Section to be 8 inches long, planed or milled edges ; its cross sectional area should be not less than one-half of one square inch, nor shall its width ever be less than the thickness of the plate.

Chemical Tests.—Not more than 0.04 per cent. phosphorous. Not more than 0.03 per cent sulphur. Percentage of carbon and maganese left to the judgment of the steelmaker.

Bending Test.—Steel up to ½ inch thickness must stand bending double, and being hammered down on itself ; above that thickness it must bend round a mandrel of diameter one and one-half times the thickness of plate, down to 180 degrees. All without showing signs of distress.

Bending Test Piece to be in length not less than sixteen times thickness of plate, and rough, shear edges, milled or filed off. Such pieces to be cut both lengthwise and crosswise of the plate.

All tests to be made at the steel mill. Three pulling tests and three bending tests to be made from each. If one fails the manufacturer may furnish and test a fourth piece, but if two fail the entire heat to be rejected.

Certified Copies of tests to be furnished each member of A. B. M. A. from heats from which his plates are made.

Flanging to be done at not less than a good red heat. Not a single blow to be given after the plate is cooled down to less than cherry red by daylight. After flanging, all plates should be annealed by uniform cooling from an even dull red heat for the whole sheet in the open air.

Rivets to be made of good charcoal iron, or of a very soft, mild steel running between 50,000 and 60,000 pounds tensile strength and showing an elongation of not less than 30 per cent. in eight inches, and having the same chemical composition as specified for plates.

SAFETY VALVES—THEIR HISTORY, ANTECEDENTS, INVENTION AND CALCULATION.

By William Barnet le Van.

(Continued from March Number.)

In 1857, James Webster was granted a patent in Great Britain (No. 1,955), for an improvement, or improvements, in safety valves. Several forms are

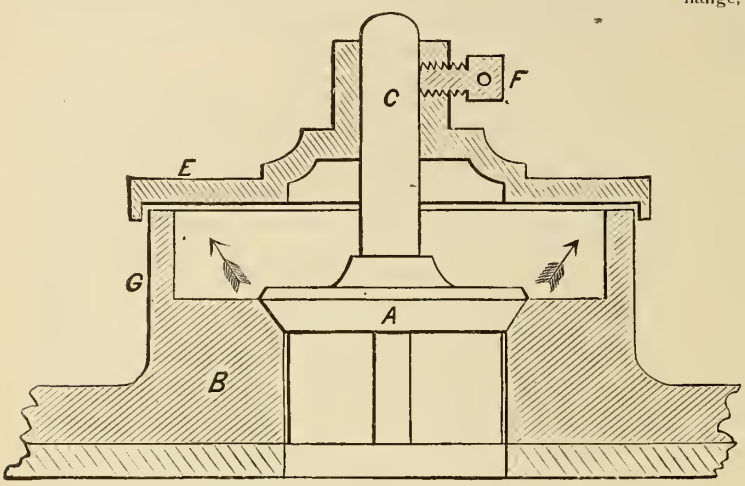


Fig. 27.—James Webster, July 14, 1857.

described in the specifications and shown in the drawings, some of them substantially identical with Ritchie's, and others equivalent thereto. In Webster's valve, the lip, or "compensating flange," instead of being formed in one piece of metal with the valve, is generally a separate and larger disk, attached to the valve stem above the valve; and the annular chamber, instead of being, as in Ritchie's, a mere concave depression around the valve sit, is a considerable chamber around and above the valve, and between the valve and the disk. The "stricture" is formed by a cylindrical ring rising from the metal of the valve sit, at a little distance from the edge of the valve, and either embracing the rim of the disk, as shown in Fig. 26—exactly as in Ritchie's device—or itself encircled by a downward-turned rim on the disk, resembling the cover of a snuff-box, a clearly equivalent device as shown in Fig. 27.

In another form, the superior disk, instead of being securely fastened to the valve stem, so as to act with the valve as if both valve and disk were one piece of metal, is connected therewith by means of a coiled spring, which admits of relative motion between the valve and the disk, as shown in Figs. 29 and 30. This is a new element, which has no resemblence to anything in Ritchie's patent.

In another form, the cylindrical envelope, or constricting ring, is closed at the top; the disk becomes a closely-fitting but freely-moving piston, and egress is given to the escaping steam by means of holes drilled through the walls of the encasing cylindrical ring, as shown in Fig. 30. There are corresponding holes in the rim of the piston, or disk, which come opposite the holes in the encasing cylinder when the valve is lifted to a desired height.

In still another form, an ordinary safety valve, with conical sit, surmounted by a short cylindrical piston rising from its outer edge, which fits closely but freely into cylindrical envelope rising from the metal of the valve sit, as shown in Fig. 31. In the form Fig. 31 there is "no

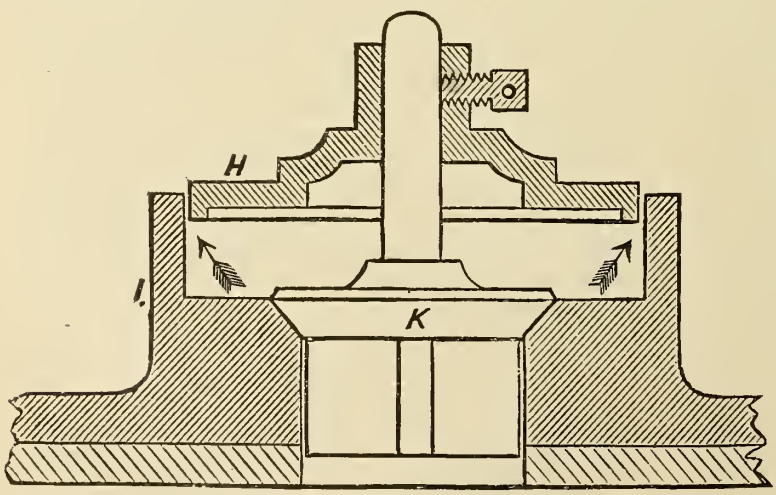


Fig. 28.—James Webster, July 14, 1857.

annular chamber," properly speaking—nothing to represent it except the space between the valve and its sit, so that there is, properly, no "stricture," and the action would be imperfect. In several of the other forms it is a good, practical safety valve.

Wm. Hartley in the same year (1857), about a month later, patented improvements in steam engine and steam boiler apparatus. He describes his improvements in safety valves as follows:

"A safety valve for steam boilers is made to open so as to discharge a volume of steam equal to the discharge of an *unobstructed passage* through the valve sit. This is accomplished in two ways:

First. By constructing a valve A, as shown in Fig. 32, with a projecting flange, on which is situated a curved, external rim B, projecting downwards, the section of the said valve and rim being similar to the section of an inverted cup, as shown in Fig. 32. When the valve is closed, the external rim is nearly in contact with the valve sit or its bearing; but when the valve is opened by the action of the steam, the distance of the rim from the valve sit, or its bearings, is equal to the area of the passage in the valve sit, thereby discharging its maximum quantity of steam.

Second. I accomplish a full discharge of steam by making the projecting rim of a cylindrical form, and the valve sit, or its bearing, curved, so as to increase in diameter downwards. In this case, when the valve A is closed, the bottom edge of the rim B nearly touches the bottom part of the curved sit, or bearing, and when the steam lifts the valve, the space between the edge of the rim and the bearing increases in area, and thus effects a full discharge of steam. The rod E is weighted when placed below the valve, or loaded by a spring if above the valve. In both of these arrangements the valve will close when the steam pressure becomes reduced below the load on the valve."

Chares Beyer also, in 1863, patented a valve similar to the above. He claims a flange around the valve, commencing at the outer edge of the valve-facing, which flange is under-cut and concave in shape, and the concave side is towards the sit of the valve, which has also a flange upon it, commencing at the outer edge of the valve sit; but the upper surface of the flange is convex, and corresponds nearly

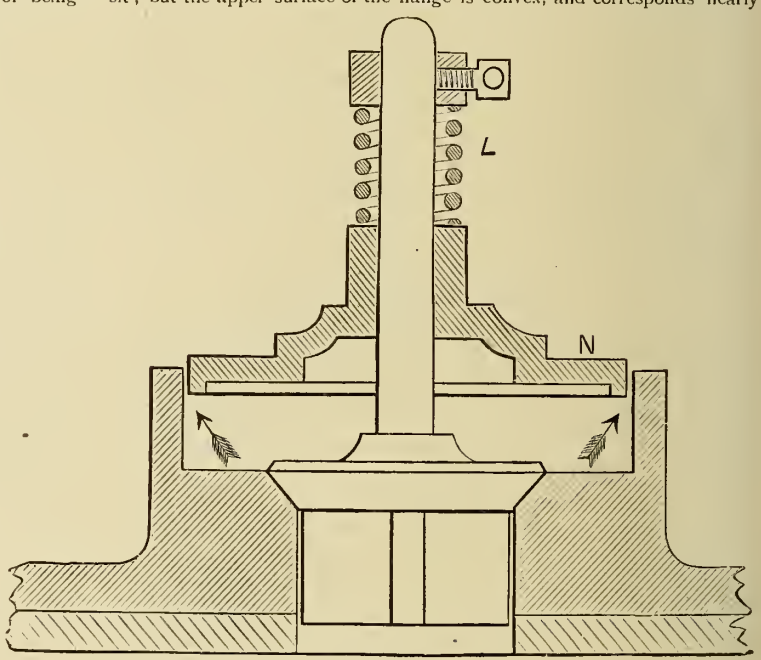


Fig. 29.—James Webster, July 14, 1857.

to the concave surface of the flange upon the valve. There is a slight space between the concave and convex surfaces of the two flanges, which diminishes towards the outer edge of the flange. When the steam begins to escape from between the surfaces of the valve, it gets between the concave and convex surfaces of the two flanges, and its force thus acts upon a larger area and reacts upon the concave surface of the valve and causes it to open to a greater extent than the ordinary safety valve.

In view of Ritchie (1848), Webster (1857), and Hartley (1857), there is in Beyer's device (1863) only a very narrow margin of novelty, if, indeed, there is anything beyond mere forms, wholly without effect upon the action of a safety valve.

In July, 1863, William Naylor patented and described a safety valve with a projecting, downward-turned lip, similar to Beyer's and to one form of Hartley's (Fig. 32), but lays no claim to its invention. He says: "By means of the curved, downward-projecting lip, I am enabled to avail myself of the recoil action of the steam against the valve for the purpose of facilitating the further lifting of such valve when once opened; but I wish it to be understood that I lay no claim to such recoil action, nor to the extension of the valve laterally beyond its sit."

Naylor's patent also contains two other devices: First, for compensating for the increasing resistance of the spring by the varying leverage of a bent lever, as shown in Fig. 34. Second, for a supplementary piston valve, for indicating the pressure existing in the boiler at all times, whether the safety valve is closed or open.

The bent lever device is eminently practical, and affords one example of a way of making a practical valve, working upon the principle of automatically relieving the boiler from excessive pressure without a considerable

enlargement of the steam passage to the atmosphere from the valve sit, followed by a comparatively quick contraction of this passage, which contraction is called a stricture.

Fair examples of reactionary safety valves in America are the Crossby and Richardson, which are well known and largely in use.

Fig. 35 represents the Richardson valve. In this valve a disk valve or cover sits upon the inner edge of a cylinder shell or body, having guides

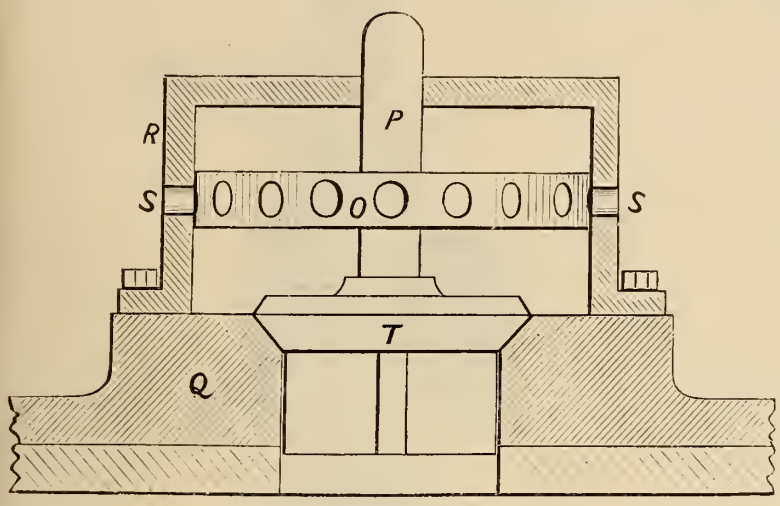


FIG. 30.—JAMES WEBSTER, JULY 14, 1857.

extending down into such shell or steam space, so far corresponding exactly to the ordinary safety valve in common use as before described. The end of the shell upon which the valve sit extends outwardly. The valve also extends outwardly from its sit, and downwards in the form of a lip, encircling the valve and relief outlet and overlapping the extended shell, and is brought so nearly to such extended shell at its edge as to form a very narrow opening to the atmosphere. These extended parts form an annular chamber. A helical spring is used to close the valve against the pressure of steam within the shell or body. The devices used to increase the lift of the valve, and give greater relief, are of such described parts as appear on the figure :

First. An annular lip C, outside and surrounding the valve B.

Second. The valve sit F.

Third. The relief outlet, shown by small arrows at lip C.

Fourth. An annular space or chamber D, formed by lip C and the extended shell E outside and surrounding the valve sit, the lip C overlapping the extended shell E slightly, and forming a very narrow annular opening from the chamher to the atmosphere when the valve is closed, but enlarging after the valve has lifted some distance from its sit.

Operation.—When the steam within the shell, or body, acting upon the whole face of the valve is sufficient to overcome the resistance offered by the spring, the valve will lift and the steam escape from the relief outlet under the valve into the annular chamber, and there expanding, and finding but a very small opening to the atmosphere, acts, but with diminished pressure, upon the additional surface presented by the overhanging lip surrounding the relief outlet, and again exerting force to overcome the resistance of the

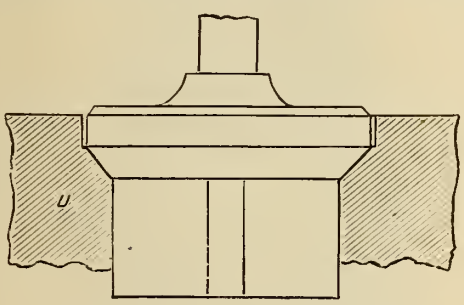


FIG. 31.—JAMES WEBSTER, JULY 14, 1857.

spring. The effect is that the valve will lift higher, but the amount of steam passing the relief outlet under the valve is increased before the annular opening at the outer edge of the lip is increased, owing to the overlap, and the valve has to lift still higher and higher to give the necessary outlet to the steam entering the chamber from under the valve, until the extra force is counterbalanced by the increasing resistance of the spring.

The steam in the chamber, by being obstructed in its course to the atmosphere by the lip, interferes with the free escape of the steam under the valve.

At the test at the Washington Navy Yard, one of these valves had two springs so arranged as to exert their strength and force in opposite directions—that is, the lower spring holds the valve down against its sit, and the upper one lifts it from its sit, so that the valve proper will open at a pressure equal to the difference between the adjusted power of the springs. For example : The lower spring is compressed sufficiently to hold the valve down at 100 pounds pressure, and the upper spring compressed to exert one-tenth of that force in an opposite direction ; that is, to raise the valve. The valve will then lift at 100 less 10=90 pounds pressure.

Fig. 36 represents a lock-up safety valve, with means upon the outside to lift it from its sit. These valves are made with either single or double springs, and without the lock-up arrangements. These valves also have an arrangement by which they can be retained in their sit whenever it becomes necessary to do so ; such, for instance, as to apply the hydrostatic test to the boiler.

The excess obtained on these valves at 30 pounds pressure, was from ½ to 7 pounds ; at 70 pounds pressure, from 1¼ to 3¾ pounds. Areas exposed at 30 pounds, 0.869, 1.171, and 1.455 square inches ; lifts, 0.15, 0.20 and 0.25 of an inch. At 70 pounds, 0.691 square inch ; lift, 0.12 inch.

The records of the trial made upon these valves show that the excesses above 30 and 70 pounds were varying, and that in some instances none at all were obtained.

The Richardson safety valves are made with a solid cast-nickel ring. Fig. 37 represents the solid nickel casting used for the valve sit. The thread on the outside is for screwing into the base of the valve. It is threaded on the inside for the head of the valve, the contact is beveled at an angle of 45° to its center line of axis, and the metal, being so hard, enables the use of a very narrow-faced joint, or contact, with no danger of its cutting. Its chemical properties prevent corrosion from the action of water, steam, fatty acids of oils, or saline matter in the water.

All valves are fitted with an adjustable screw ring, so that the popping point can be changed while steam is in the boiler, without breaking any joints. These valves are absolutely reliable in their action, prompt in opening and closing at the proper moment, and *fully sufficient in capacity* to relieve the boiler from any pressure in excess of the amount intended to be carried. Figs. 38 and 39 show the different areas of the ordinary and this valve.

The usual diameter of safety valves in use in the United States on locomotives is 2¼ inches diameter, and each boiler is fitted in duplicate. Fig. 40 shows the spring F, which is the vital factor of spring-loaded safety valves. These springs are carefully selected, and the greatest care is used in the coiling, tempering and testing of the same. They are nickle-plated, to protect them from rusting.

The points of bearing, top and bottom, are ball and socket, preventing

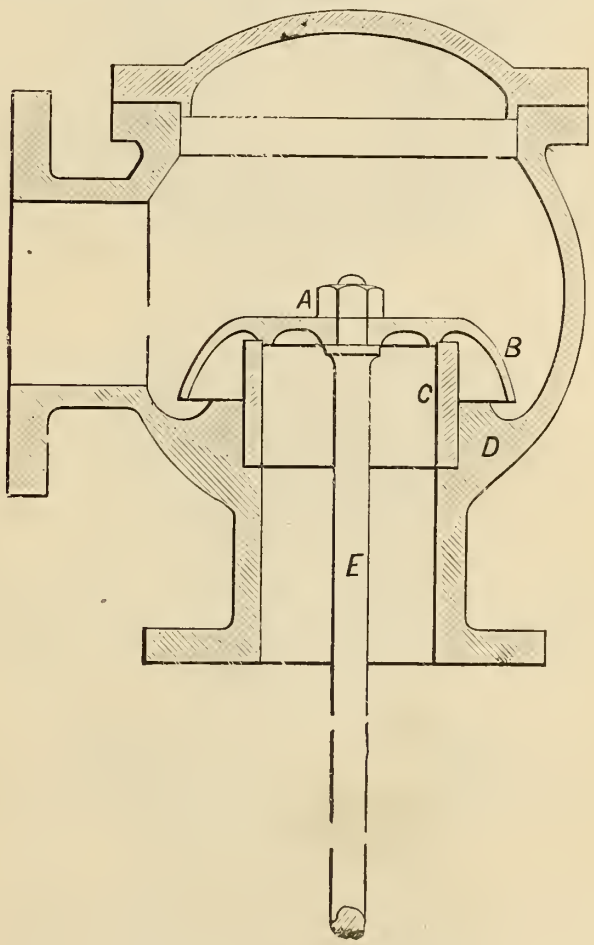


FIG. 32.—THE HARTLEY VALVE, AUGUST 19, 1857.

any tendency to tilt to one side and bind the spindle D, through which the pressure to hold the valve on its sit C is transmitted, and makes the valve thoroughly reliable.

The lip C' is adjustable. If the valve reduces the pressure in the boiler too much, loosen the set-screw L and turn the ring up a notch at a time ; if it reduces the pressure too little, turn the ring down a notch at a time until the desired pressure is reached, and then turn down the set-screws L L. The notch is shown at K.

THE CROSBY SAFETY VALVE.

The sits of this valve are flat, and it is claimed that the sits do not wear

out or leak so readily as beveled sits, and *will never stick.* This valve in adjustable also ; the point of opening can readily be changed while under steam by screwing the threaded bolt L at the top of the cylinder up or down.

The Crosby valve has a compound or annulus-disk valve sit at its periphery

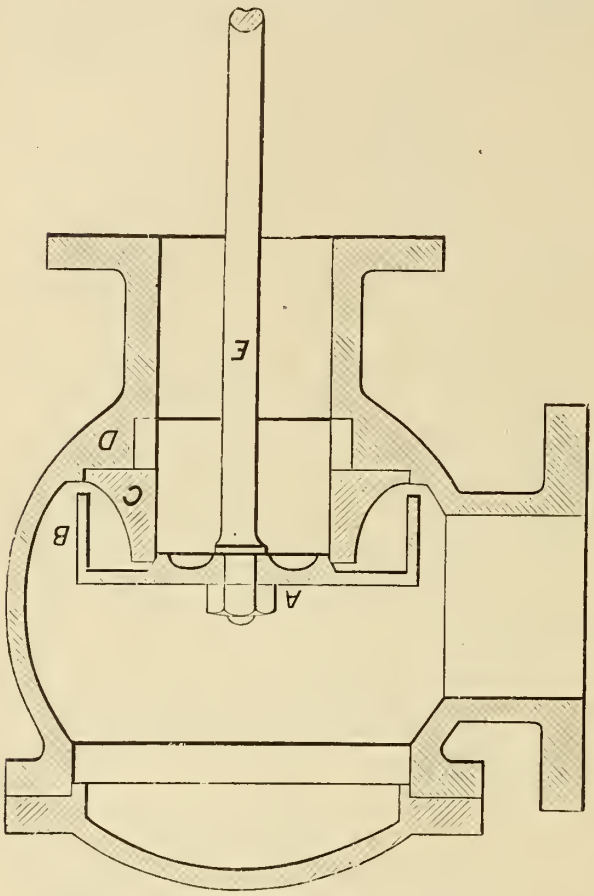


Fig. 33.—The Hartley Valve, August 19, 1857.

upon the edge of a cylindrical shell or body, and having guides projecting downward from the centre of the valve into a cylindrical chamber situated under the centre of the valve and inside of the space enclosed by the shell or body, and to which the steam has no access when the valve is closed. The boss, or chamber, is held in its position by radial arms connected with

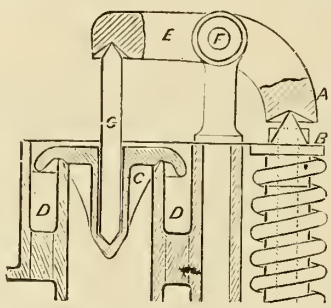


Fig. 34.—The Naylor Valve, July 21, 1863.

the shell. The upper face of such boss, or chamber, is arranged to come in contact with, and protect, a certain portion of the face of the valve itself from the action of the steam pressure, until the valve opens. Openings are made from this chamber, or boss, through the radial arms and shell, or

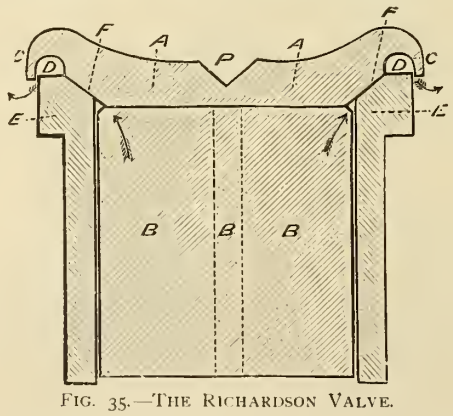


Fig. 35.—The Richardson Valve.

body, to the atmosphere, and a ring or sleeve is screw-threaded to the outside of the body to regulate the size of such openings. A helical spring is used to close the valve against the steam pressure within the shell.

The devices used to give a greater lift to the valve are such boss, or cylindrical chamber, C C, with its upper face W W, smaller than the valve B B, and, as has been described, and as appears from the cut annexed, so situated inside of the shell or body, that its upper face shall come in contact with and protect a portion of the face of the valve itself from the action of the steam pressure within the shell until the valve opens ; and the small

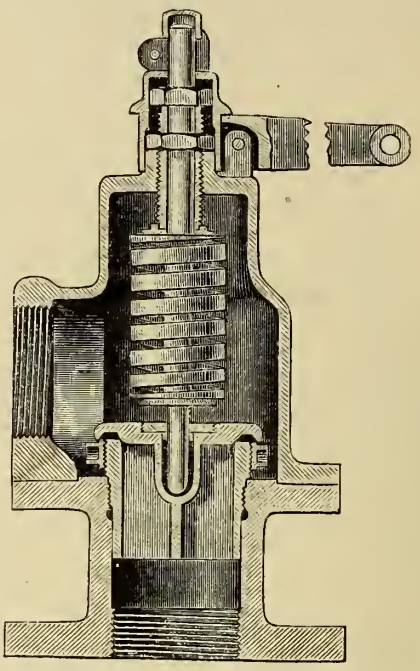


Fig. 36.—Lock-up Safety Valve.

openings E E, from the boss, or chamber, through the radial arms and shell to the atmosphere. The size of these openings can be varied by the operator at will, but not by any action of the valve.

OPERATION.

When the steam w thin the shell, or body, acting upon that portion of the face of the valve not covered by the face of the boss, or chamber, is

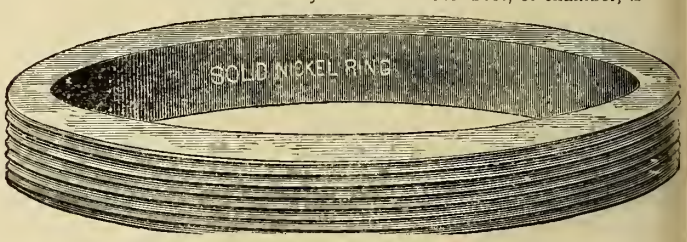


Fig. 37.—Solid Cast-Nickel Ring.

sufficient to overcome the resistance offered by the spring, the valve will lift and the steam will escape from the relief outlet under the valve at its periphery into the atmosphere unobstructed, and no further use is made of it. At the same time that portion of the face of the valve itself which was protected by the boss, or cylindrical chamber, from the action of the steam pressure is uncovered, and the steam acts upon such surface with great

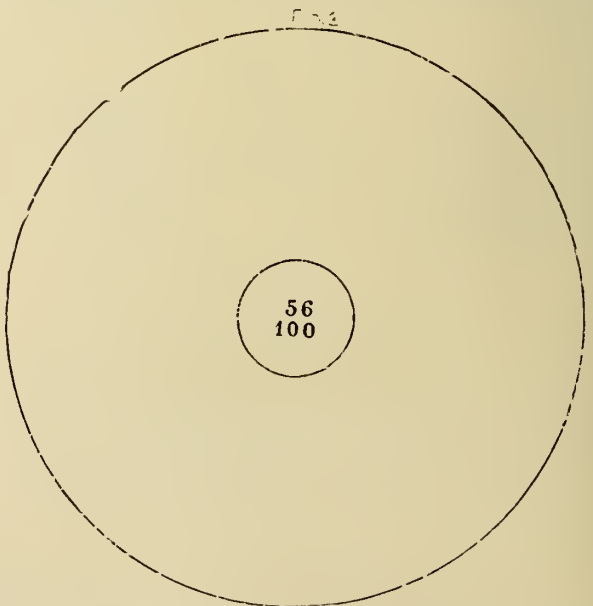


Fig. 38.—Three-Inch Common Safety Valve, and the Area of Opening Presented when the Valve Lifts for the Escape of the Steam.

power also, and exerts a force to overcome the resistance of the spring. In lieu of changing this central area for every change of pressure required, the pressure acting upon the fixed central area of the portion of the face of the valve so uncovered is reduced to the proper amount by the size of the openings from the boss, or chamber, at their outlet.

The effect is, that the valve will lift higher and the relief outlet is enlarged to any degree desired without the slightest obstruction to the free escape of the steam under the valve into the atmosphere.

The navy yard trials showed that the excess obtained on this valve at 30



FIG. 39.—SHOWS THE NICKEL-SEATED SAFETY VALVE, AND THE AREA FOR THE ESCAPE OF THE STEAM WHEN THE VALVE LIFTS.

pounds pressure was from 2½ to 5¼ pounds ; at 70 pounds pressure, from 3 to 5 pounds.

Areas exposed at 30 pounds, 1,257 square inches ; lift, 0.12 inch ; at 70 pounds, 0.729 square inch ; lift, 0.07 inch.

These excesses were only temporary, and upon trial after readjustment no excess was obtained, but the range of pressure between the opening and closing points was about the same on all the trials ; that is, if the valve made less excess, or none at all, it seated at a lower pressure.

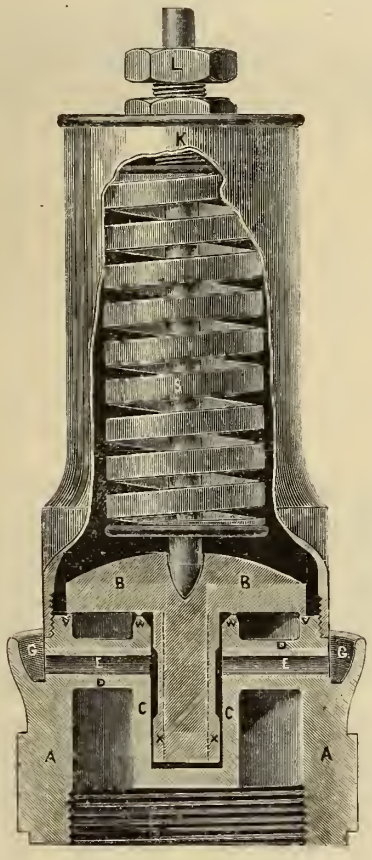


FIG. 41.—CROSBY LOCOMOTIVE "POP" SAFETY VALVE.

THE AMERICAN POP SAFETY VALVE.

This safety valve is provided with a second or movable head on the top of the valve proper, as shown in Fig. 42 :

MOVEMENT.

H—Valve.

J—Inclined holes in automatic head G.

G—Adjustable automatic head on top of valve H.

S—Spring to return the head to its position after the valve has stopped blowing.

P—Cavity for the accumulation of steam to feed holes through valve H, and head G.

There are two series of holes drilled around the outer edge of these heads, for the purpose of reducing the amount of increased area.

First. The first series is drilled around the head of the valve proper and drilled at an angle of 90° and the sit of the same.

Second. The series is around the second or movable head G, and drilled at an angle of 55° with the holes in the head of the valve H.

Now, the movable head is placed in such a position upon the head of the valve H, that there is a small opening between the holes in the head of the valve H, and in the corresponding holes in the second or movable head G.

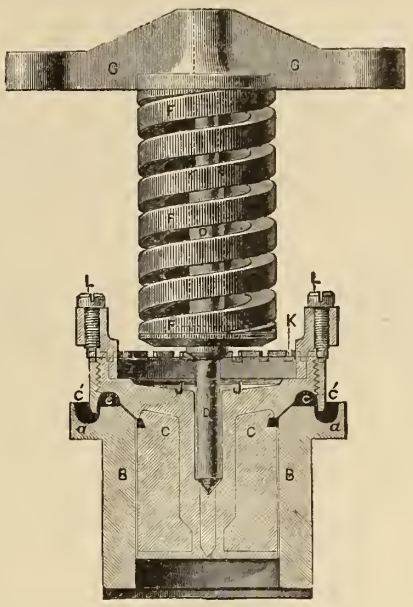


FIG. 40.—RICHARDSON'S OPEN LOCOMOTIVE "POP" SAFETY VALVE, WITH ADJUSTABLE SCREW RING.

It will readily be seen that the result of this device is simply this, that when the valve lifts from the sit to blow, the passage of the steam through the holes in the head of the valve H passes into the corresponding holes in the movable head G ; and as the walls of the holes in the head G are at an angle

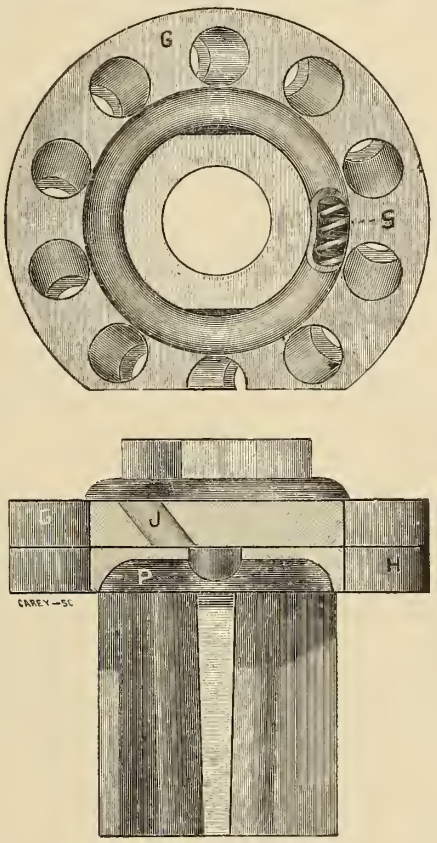


FIG. 42.—THE AMERICAN POP SAFETY VALVE.

of 55° with the holes in the head of the valve H, the automatic head G will be forced around in such a manner that the holes of the two heads will be directly in line with ecah other, the result being a decrease of increased area.

(To be Continued.)

T. W. Ness & Co., of Montreal, have secured the Canadian agency for the Zurich Incandescent Lamp Company, Switzerland.

The Hamilton Electric Light and Power Co. have recently installed a 1500 light alternating dynamo, complete, with transformers, made by the Royal Electric Co.

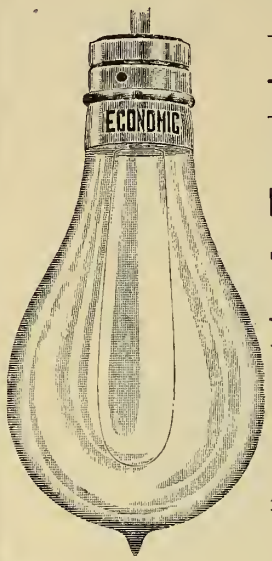
The Ball Electric Light Company, Ltd., 70 Pearl street, Toronto, report the following recent sales of their apparatus : Beardmore & Co., leather merchants and manufacturers, 6 h.p. Ball motor ; Imrie & Graham, printers and publishers, 7 h.p. Ball motor ; Potter & Co., furniture warehouse, 6 h.p. for running elevator ; Toronto Engraving Co., 1 h.p. motor ; E. Dack & Son, shoe manufacturers, 2 h.p. motor. All of the above in Toronto. Also the following automatic incandescent dynamos : D. Hibner & Co., furniture factory, Berlin, Ont., 80 light, 16 c.p. ; W. Shaw, tannery, Bracebridge, Ont., 40 light, 16 c.p. ; J. Bertrand, St. Hyacinthe, Que., 25 light, 16 c.p. Arc plants : Hawkesville Lumber Co., Hawkesville, Ont., 35 arc, 4 ampere ; also a 4 h.p. motor for arc circuit to same company ; McGowan & Co., Oakville, Ont., 50 arc, 4 ampere, etc., etc.

THE ADVANTAGE OF LONG DISTANCE TELEPHONING.

In an interview with Superintendent Mallett, of the Bell Telephone Company, by a representative of the *Post-Express*, of Rochester, N. Y., the advantages of the long distance service were very clearly and concisely put.

In response to a question on the subject, he said : "Business men are availing themselves of its advantages to carry on communication that could not be done by telegraph. They can discuss questions and negotiate as though they were face to face. The metallic circuit in use on the long distance line conveys the message perfectly. Where one has a city telephone with a metallic circuit he can get a message from New York or Boston in his own office. But with the ordinary ground circuit, one living here could send a message to New York that would be understood, but he would not be likely to receive a distinct one in return. A new line has been opened to Pittsburgh, and it is now being extended to Chicago. There is a comparatively greater demand for long distance service in New York, Philadelphia and Boston than elsewhere. The greater population at these points does not account for it altogether ; the value of the system appears to have received quicker recognition there. In the city of Rochester there is one firm that pays $75 to $80 a month for its telephoning, and another paid over $125 last month."

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SPARKS.

Mr. Frederic Nicholls recently delivered an address before the Toronto Architectural Guild on "Interior Wiring."

A line of poles on Rideau street, Ottawa, recently gave way under the weight imposed on the wires by a heavy fall of wet snow. For a short time the electrical business of the city was badly tangled up.

The National Electric Lighting and Tramway Company, of Victoria, B. C., has just purchased a 260 horse power Edison railway generator and two complete car equipments of 30 horse power each of the latest single reduction type.

The carbon manufactory of the Brooks Mfg. Co., at Peterborough, Ont., was recently damaged by fire to the extent of $7,000 or $8,000. Within a month the company hope to have the building reconstructed. Fortunately they have a sufficient stock of carbons on hand to supply the demand in the meantime.

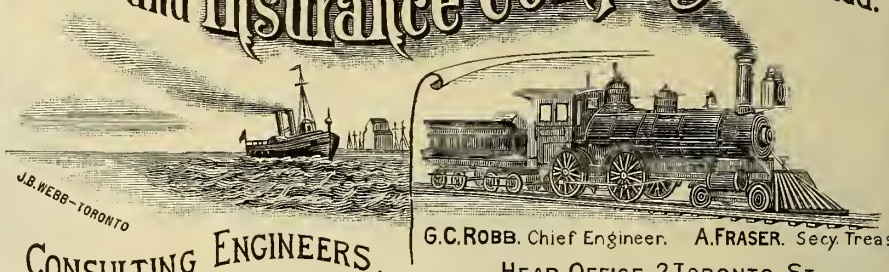
The new boat now being built for the E. & N. R. Co. by the Albion Iron Works at Victoria is to be equipped with electricity. The boat is to be wired throughout by the Edison Company, and the fixtures are to be very handsome and durable, and to be finished by the new process of coating with aluminium, which is proof against the action of salt water or steam. When finished it will be one of the most perfect boats on the Pacific coast so far as the electrical arrangements are concerned,—Vancouver *News-Advertiser*.

A stock company has been organized in Chicago for the purpose of introducing an invention which it is claimed, will eventually do away with the telephone girl. The invention is described as follows :—On the telephone shelf is a row of keys, five in all. They are marked units, tens, hundreds and thousands, the fifth key being the release key. The subscriber taps out the desired number on the key-board, which, registering on the machine automatically, connects the wire of the subscriber with that of the 'phone he desires to reach. The connection is made with the taps on the key-board. The subscriber wishing to place his transmitter and ear 'phone in connection with those of any other can do so by successively pressing the key which causes the circuit closer to move. If the man at telephone No. 288 wishes to place himself in connection with telephone No. 315 he will do so by pressing the key marked hundreds three times, then the key marked tens once and then the key marked units five times. His circuit closed is then in contact with wire terminal No. 315. The person at telephone No. 315 will take down his ear 'phone and the two are then able to converse with each other. The contrivance takes up a space of but 6x4x4 ins. The management of the Minneapolis telephone exchange does not believe the invention is of any practical use.

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SPARKS.

The Berlin, Ont., Gas Company have lately put in operation two new Edison incandescent dynamos.

A motion pending in the Toronto courts to quash the by-law passed by the Township of Etobicoke, granting a bonus of $20,000 to the Toronto and Mimico Electric Railway has been dismissed.

At a recent meeting of the shareholders in the Davenport Electric Street Railway Company, Messrs. Robert Jaffray, William Booth, Barlow Cumberland, Allan Royce, C. E., and B. E. Bull were elected directors. At a subsequent meeting, M. Frank Turner was elected president of the company, and Mr. William Booth vice-president.

James P. Wooley, Simcoe, Ira N. Vail, Township of Woodhouse, and Thos. E. Vail, Township of Townsend; Ont., have been granted a patent for Canada on a cut-off for electric machinery, consisting of a movable plate connected to one pole of an electric circuit in contact with a plate connected to the other pole of the circuit, an electro magnet supporting a weight connected to the movable in such a manner that it will break the contact between the two plates the instant the electro magnet is demagnetized.

The contract for the equipment of the Toronto and Mimico Electric Railway, exclusive of track, has been given to the Reliance Co.. of Waterford, Ont., who are manufacturers in Canada of the Rae System. Single reduction motors will be employed. The power station will contain one Armington & Sims engine of the compound condensing type, 125 horse power, and the Rae station railway apparatus consisting of one 85 kilowatt generator, and the necessary appliances. The road will start from the terminus ot the Toronto Street Railway company's lines on Queen street, and extend to the village of Mimico, and eventually to Long Branch, a total distance of about seven miles, running along the lake shore the entire distance.

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The United States courts have granted to the Brush Electric Light Co., a perpetual injunction restraing the United State Electric Lighting Co., from using the double-carbon lamp, which was patented by Charles Brush September 2, 1879, and has ordered that testimony be taken of the amount due the Brush Co., for infringement of the patent

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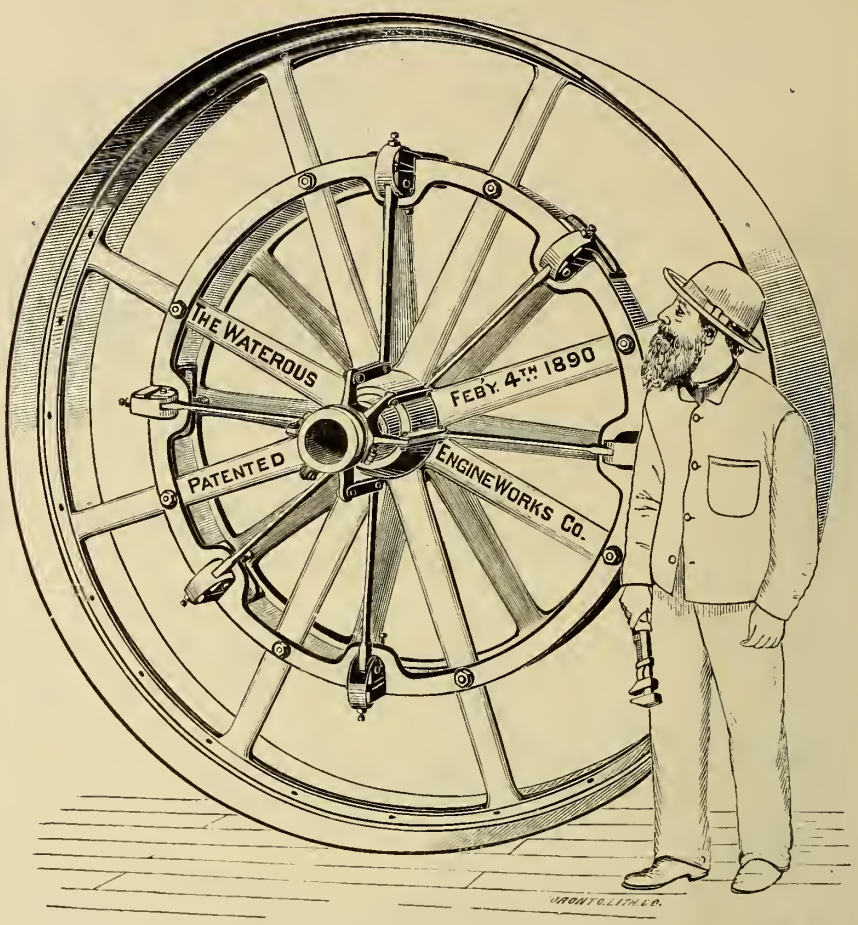
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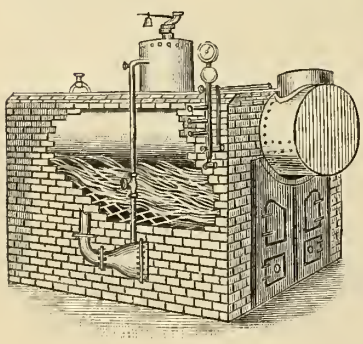
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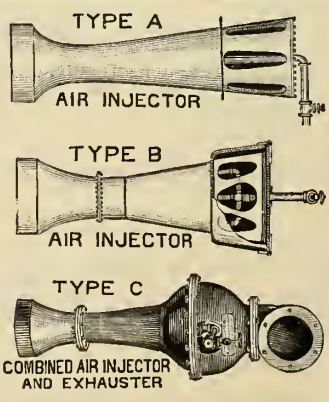
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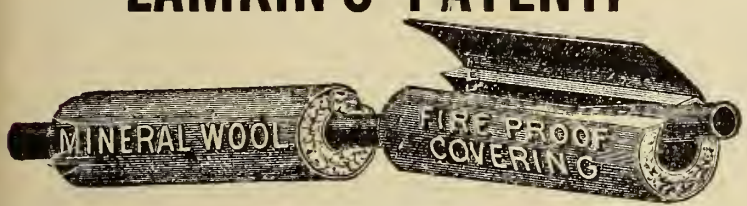
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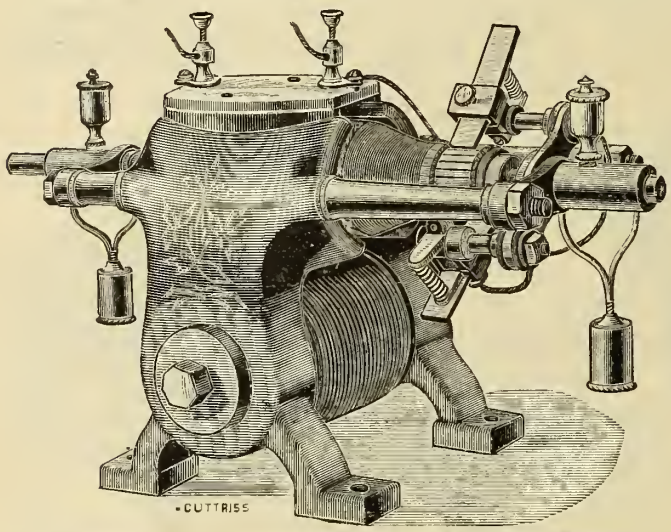
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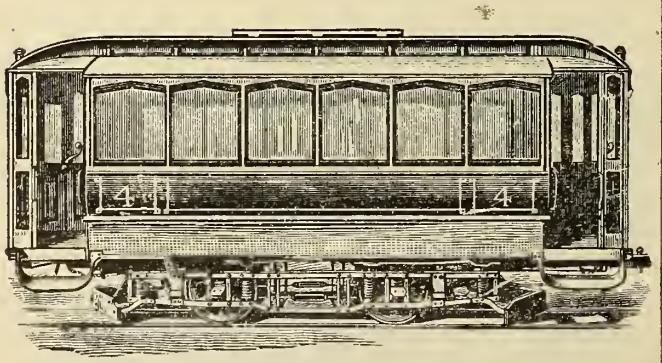
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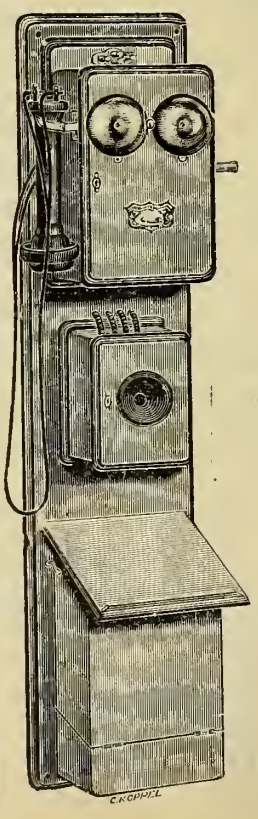
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We also manufacture Horse and Trail Cars of every description.

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NOTICE OF REMOVAL.

WE beg to announce that we are removing this month to new premises,

749 CRAIG STREET,

where with larger accommodation and greatly increased facilities, we will be in a better position than ever to turn out our standard Main Line and Warehouse Telephones. Send for catalogue of Electrical Supplies of all kinds. Note a couple of sample testimonials:

WATFORD, ONT., Feb. 9, 1892.
T. W. NESS, Montreal, Que.

DEAR SIR,—We wish to secure four (4) of your telephones as soon as you can ship them to us. The ones we got from you last gave good satisfaction.

Yours truly, DRS. McLEAY & AULD.

MILVERTON, ONT., Nov. 9, 1891.
T. W. NESS, ESQ, Montreal.

DEAR SIR,—The whole line is working first-class. Any one wishing to know about your telephones, you can refer them to me. I think any person with ordinary intelligence could set them up.

Yours truly,
J. F. CATTERMOLE, M.D.

MONTREAL, April 7, 1892.
T. W. NESS, ESQ., City.

DEAR SIR,—Replying to your favor of the 5th inst., we beg to say that the telephone instruments which you put into our mill last year to connect our different departments are working very satisfactorily, and we find them a great convenience. We would certainly recommend anyone desiring a system of telephones for their works to adopt those made by you.

Yours truly,
DOMINION WIRE MFG. CO.

T. W. NESS

749 Craig Street, - Montreal.

CANADIAN

ELECTRICAL NEWS

AND

STEAM ENGINEERING JOURNAL.

VOL. II. TORONTO AND MONTREAL, CANADA, MAY, 1892. NO. 5.

CANADIAN ELECTRICAL ASSOCIATION.

FOR the benefit of those who may never have had an opportunity of seeing for themselves its attractiveness, we publish views of some of the interesting features of the city of Hamilton, which has been selected for the first annual convention of the Canadian Electrical Association on the second Tuesday in June. Fortunately the convention is to take place at the pleasantest season of the year, when the city may be expected to appear in its best attire.

From an electrical standpoint, also, the city will be found to afford much interest and instruction to visitors. The Bell Telephone Company's new exchange is right up to date in point of equipment, and will be open for the inspection of those who may be on the lookout for pointers in this line. The new central station of the Hamilton Electric Light & Power Co., will also have been completed, and if we are rightly informed will alone well repay the visit of every convention delegate who is interested in this important branch of the electrical business.

Those interested in electric railways will find a valuable object lesson in this department of electrical work in witnessing the methods employed in the construction of the Hamilton street railway. The convention itself will undoubtedly be one of much interest. The following subjects, amongst others, have already been arranged for discussion :—"The Financial Aspect of Electric Lighting in Canada," introduced by Mr. S. J. Parker, of Owen Sound ; "Long Distance Telephony," with illustrations, by Mr Neilson ; "Safe Wiring for Electric Installations," by Mr. A. B. Smith ; "Line Construction," by Mr. Wadland ; "Central Stations," by Mr. D. Thomson ; "Carbons," by Mr. Fisk ; "Steam and Electric Power," by Mr. J. J. Wright ; "Multiple Switchboards," by Mr. Baylis. Questions of interest respecting electric railways and kindred subjects will also be introduced. Accommodation (including power) will be provided for manufacturers desirous of making exhibits of electric apparatus. It is yet too early to speak definitely regarding the social features of the occasion, but knowing as we do the energy of the members of the Association resident in the city, and the hospitality of the citizens, we have no hesitation in declaring that every visitor will find ample means of enjoyment in whatever time he may have at his disposal apart from the sessions of the convention.



VIEW AT THE GORE, HAMILTON, ONT.

Altogether, the indications point to a time of much profit and pleasure as being in store for those who shall take part in this first convention for the consideration of questions affecting electrical interests and progress in the Dominion. We would advise every interested reader to fix the date in his mind and memorandum book, and make it a point to be present.

SUBSIDY FOR A CABLE TO JAPAN.

It is officially announced at Ottawa, that the Canadian Pacific Railway has received positive assurances that the Imperial Government will grant a subsidy toward the construction of a new submarine cable between British Columbia and Japan. President Shaughnessy of that railroad, who has just arrived from Yokohama, says that arrangements have been made with the Mikado's Government for the use of land lines in Japan. Efforts are now being made among English capitalists to raise the money and float a company to undertake the construction and operation of the proposed cable in conjunction with the Commercial Cable and the Canadian Pacific route, as already chosen. This route presents very few obstacles and is certainly much better than the Southren Pacific route.

THE BOWMANVILLE ELECTRIC LIGHT COMPANY.

DURING the fall and winter of 1886-7 the plant now owned by the Bowmanville Electric Light Company, commenced operations. The water power and site formerly occupied by McDougall's flour mills one mile north of the town was purchased and a central station erected under the supervision of Mr. Stephen Wright and Mr. M. Sanford. One thirty-five light eight ampere Ball dynamo was installed, and lights were placed in a number of stores and four lights on the streets on approbation.

In the following spring the present company organized with Mr. John McCellan as president, and Mr. W. J. Jones as secretary-treasurer, which positions they still hold. A three years contract was then made with the town for fifteen street lamps, since increased to nineteen, and a new twenty-five light Ball machine was purchased. In 1889 this machine was exchanged for a forty lighter, so that the capacity of the station at present is seventy-five arc lights.

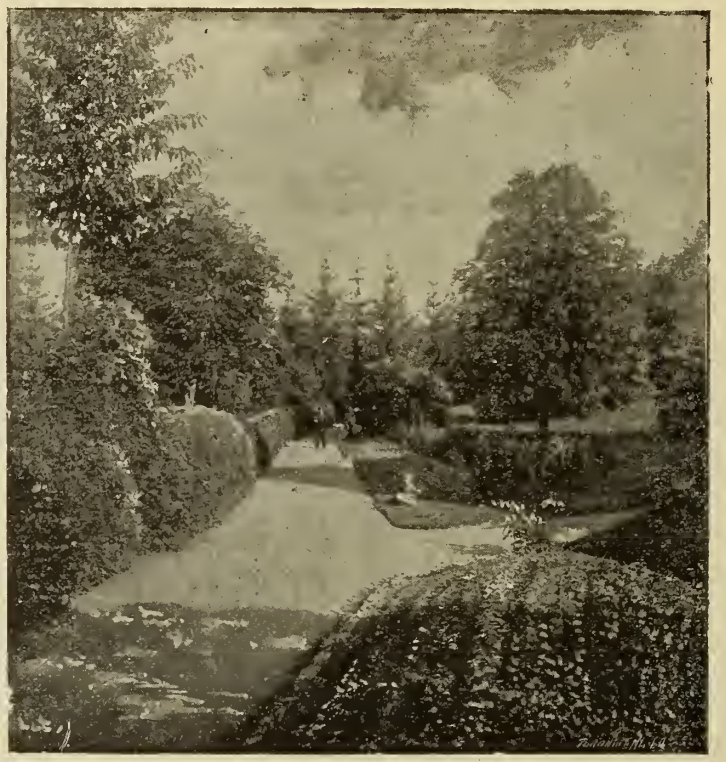
The pond covers an area of about twenty acres and gives a head of water of twenty-two feet. The machines are driven by three Leffel wheels, two twenty inch wheels of twenty-five h. p. each connected to one shaft driving one machine, and one twenty-six inch wheel of forty-five h. p. driving the other, so that either machine may be stopped, started or run at any desired speed independently of the other.

The station is connected with the town office by telephones owned by the company. They are placed on a metallic circuit to prevent induction, which on a grounded circuit of that length would be very bad owing to the close proximity of the light mains.

Owing to the noise at the station made by the machines the telephone had to be placed in a room separate from the dynamo room, so that the present superintendent invented a small piece of apparatus which causes an incandescent lamp to be lighted whenever the bell rings and it remains lighted until the telephone has been answered, when it is set ready for the next ring.

About sixty arc lamps are now in use and twenty-five Bernstein incandescents. A record is kept of the time each machine is started each night, and the circuit on which it is run.

There are two circuits embracing about twelve miles of wire, one of which has on it store lamps only. The other has the street lamps, hotels, churches, and all lamps which have to be run on Sundays and holidays, so that one machine does all the work when the store lamps are not required. The motto of the station is, "Cleanliness is next to Godliness." Mr. F. G. Proutt, who was for three years with the Bell Telephone Co., has been in charge for the past two years.



VIEW AT THE RESERVOIR, HAMILTON, ONT.

ELECTRIC LIGHTING FROM A FINANCIAL STANDPOINT.*

BY ERASTUS WIMAN.

AS a matter of course the profitableness of any undertaking depends upon the price obtained. In my judgment electric light projectors are themselves to blame for loss of profit through false representations as to the economy of operation. If the truth had been told, and contracts refused except upon a paying basis, the electrical business throughout the country would now be upon a much better footing.

The promoters of electrical enterprises, and the sellers of electrical apparatus and appliances are rapidly killing "the goose that lays the golden egg," by falsely representing the great economy of operation, and consequently the great profits of such undertakings, thus falsely educating the public into the belief that anything like a reasonable price is extortionate.

The policy of the friends of the electrical industry should be directed in just the opposite course to that which you propose pursuing, namely, to show that electrical undertakings, upon the basis of the present prices *are not profitable*, and if they expect perfect service they must pay better prices, prices that have prevailed because the companies themselves have not heretofore appreciated and understood the cost of operation, and the great loss due to accidents and rapid depreciation.

These two extremes of success and failure tell the whole story of electric lighting in the past seven years. The companies that have succeeded have done so under favorable circumstances, with a freedom from ruinous competition, exacting good prices, and above all other requisities, with good management. If there is any department in human activity where brains and tact are required to a degree greater than any other, it is in the administration of an electric lighting plant. This is evident, not only because there was a great lack of experience and knowledge of a business that was in the production of an article that was in a certain sense mysterious and unknown, but because there has been an amount of misapprehension as to its cost on the one hand and its value on the other, hardly ever experienced regarding any article of merchandise.

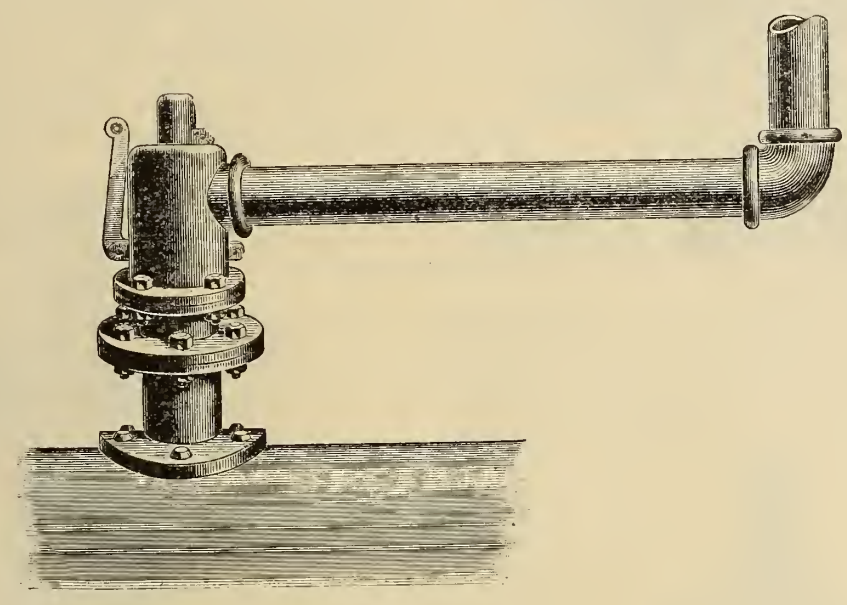
Some attempt has already been made to account for a misunderstanding as to the cost of electric lighting, but it is proper to allude to the folly which has prevailed in selling it for less than cost. The insane competition with each other in localities where one company was needed and more than one was ruinous is well-nigh passed, but there remains the competition with gas companies and the effort made to constantly lower the standard of electricity to that of gas. It is true that in the early history of the effort to use electricity as an illuminant, it was necessary to get down to the fumes of coal, and in order to show the superiority of one over the other, to yield for a time in the matter of profit. But so rapid has been the growth in the use of electricity, so immeasurably superior is the current to fume, in health, in brilliancy, in beauty and attractiveness, that the time seems near when electricity can claim the rightful place, and demand the price just so much higher as it is an illuminant just so much better. It took sixty years to introduce gas and make it a reliable servant of man. Its early history shows losses quite in proportion to those in electricity, while its later progress shows that long ago it reached its limit of illumination, its possibility of moderate profit, its constancy of danger, and its maximum of unhealthfulness. It has remained for electricity to show in every new edifice, in every modern place of public resort, in almost every commercial centre, in banks and hotels, as well as in thousands of miles of street lighting, how immeasurably superior is the electric globe of light to the meagre and inefficient gas-burner. With this achieved, and a general verdict in the public mind as to the superiority of one over the other, is it not time to break away from a similarity of price, as we have broken away from a similarity of production? An advance in price commensurate with the superiority in the article produced, would add largely to the earning power of electric lighting companies, and it is time it was contemplated and acted upon.

*Abstracts from paper read before the National Electric Light Association, Buffalo, N. Y., February 24, 1892.

DANGEROUS POP-PALVES.

THE pop-valve is coming into pretty general use on stationary boilers, the chief objection to it, we believe, being its expense. It responds quickly when the steam pressure exceeds the working limit, and, being direct acting, it has no levers that can get cramped, and the only way it can get fast is by the valve adhering to its seat, which is not likely to happen if it receives proper attention. Moreover, the pop-valve can be locked up, so that irresponsible persons cannot tamper with it or change the pressure at which it is set.

There is one feature about the pop-valve, however, which may make it dangerous. In many cases a waste-pipe is attached to the escape opening in the manner shown in the cut, the horizontal pipe being, say, four feet long, and the vertical pipe long enough to direct the outflow of steam upward, or perhaps long enough to pass through the roof so as to discharge out of doors. Usually no adequate support is provided for the waste-pipes that are put on in this manner, such support as there may be being intended only to relieve the valve-casing of the weight of the pipe. Now, when the valve blows off, the escaping steam rushes upward through the escape pipe, and creates a downward reaction that brings a severe strain on the outside casing of the valve. Suppose, for example, that the waste-pipe is four inches in diameter, and that the pressure at which the boiler blows off is 100 pounds per square inch. The area of a four-inch pipe is 12½ inches, and a reactionary pressure of 100 pounds per square inch acting on this area would give a total downward reaction of 1,250 pounds. This, acting at the end of a four-foot lever (*i.e.*, the waste-pipe), would bring an enormous strain on the casting that forms the outside of the valve; and it should be borne in mind that this casting is all that holds the valve together, so that if the casting should fail under the strain, the entire valve would be blown from the boiler, and in a few moments the entire contents of the boiler would be blown out. The result would probably be that the boiler would be burned before the fire could be drawn, to say nothing of the likelihood of scalding employés. Several accidents of this kind have come to our attention recently, and we do not doubt that others will continue to happen unless this arrangement of the waste-pipe is discarded. To appreciate the danger fully, one only needs to be on the top of a boiler arranged in this way when the valve blows off.



A DANGEROUS ARRANGEMENT.

It might be objected that the full head of steam is not realized at the end of the waste-pipe, and that the strain on the casting would therefore be materially less than is indicated above. In reply to this we may say that even if the reactionary pressure is but 50 pounds to the square inch, the total reaction in a four-inch pipe will be 625 pounds, and this, if the pipe is four feet long, will bring a bending moment on the casting of the valve 4×625=2,500 foot-pounds, which is quite sufficient to endanger the casting if there should happen to be a flaw in it, and to bring on the bolts that fasten the casting to the neck below, a strain that is greater than they can stand with safety.

If this form of attachment is to be used at all, the outer end of the pipe should have a substantial support, capable of safely bearing a weight of a ton or so; and some method of draining the pipe should be provided, in order that it may not fill with water and set back into the valve. The valve is provided with a drip opening, it is true, but it is well to incline the waste-pipe downward and put an opening in it near the elbow (at the right-hand end in the cut), in order that any water in it may pass off freely without running back through the valve-casing.

We advise that the waste-pipe from safety-valves, if any be used, should be a simple, straight piece of pipe, without elbows and dipping slightly downward, so that water may run out freely. We also advise that the waste pipe should open *in the boiler-room*, unless the available space is so small as to make this impracticable. We have known of a number of accidents that were caused by the freezing up of the outer ends of waste-pipes discharging out of doors. If the boiler-room is small, however, and the valve is large, it may be dangerous to blow off in the room, for pop-valves blow so suddenly that there is danger of the fireman being scalded, unless there is a large free space to blow into. Numerous fatal accidents have been caused this way.

Setting a pop-valve under working pressure is always a dangerous proceeding, A safe way to set such a valve is to adjust it when the steam pressure is far below the blowing-off point, and test it by bringing the steam pressure up to the point at which it is desired to blow. A further adjustment is made the next time the pressure is down, and after several attempts are made in this way, the valve may be brought to the desired blowing-off point. This process is a long and tedious one, and the same degree of safety and accuracy may more quickly be attained by filling the boiler with hot water and adjust the valve under water pressure, which may be done without danger.—*The Locomotive.*

THE CANADIAN ELECTRICAL ASSOCIATION.

THE National Electric Light Association, since its inception, has been doing good work for the electrical interests of the United States. Although at the beginning of its existence it was thought by some that it was directly opposed to the business interest of the parent companies, yet its work has conclusively shown on the contrary that it was of mutual benefit all round. Although central station interests received the larger part of its attention, the exchange of opinion and the suggestions offered, proved to be beneficial to all concerned. Our Canadian friends, through the information obtained from the meeting of the National Association in a Canadian city, at its last session, have formed the Canadian Electrical Association, which will follow in the path of its contemporary and endeavor to advance the electrical interests of the Dominion in the same extensive and substantial way as has been done in the United States Owing to the short time that electricity has been in use for so many diversified purposes, the increased number of applications that are constantly being made show that it has a field, wholly its own, in which no effort will be necessary to expel any force that may now have a strong footing, but rather it will work in conjunction with those already established for the increased benefit of both and the greater usefulness to mankind in the development of natural resources. If our Canadian friends will go at the work with the same degree of energy as was shown by the National Association, the improvement of the rich land to the north will follow with surprising rapidity.—*Stationary Engineer.*

The commutator is a device for causing the current which flows from the armature alternately in opposite directions to flow into the circuit in one and the same direction. It is built on the armature shaft and consists of a metallic cylinder which is divided into as many segments in pairs as there are electro-magnets or armature coils. The ends of the wires from the electro-magnet or magnets or the coils used in building up the armature are connected with these segments or commutators. The current is taken off from the commutator by means of collecting brushes that rest thereon as the commutator is revolved.

SAFETY VALVES—THEIR HISTORY, ANTECEDENTS, INVENTION AND CALCULATION.

By William Barnet le Van.

(Continued from April Number.)

Fig. 43 shows a section of the inside of a safety valve.

The United States Board of Supervising Inspectors of Steam Vessels require for *lever* safety valves, one square inch valve area for every two

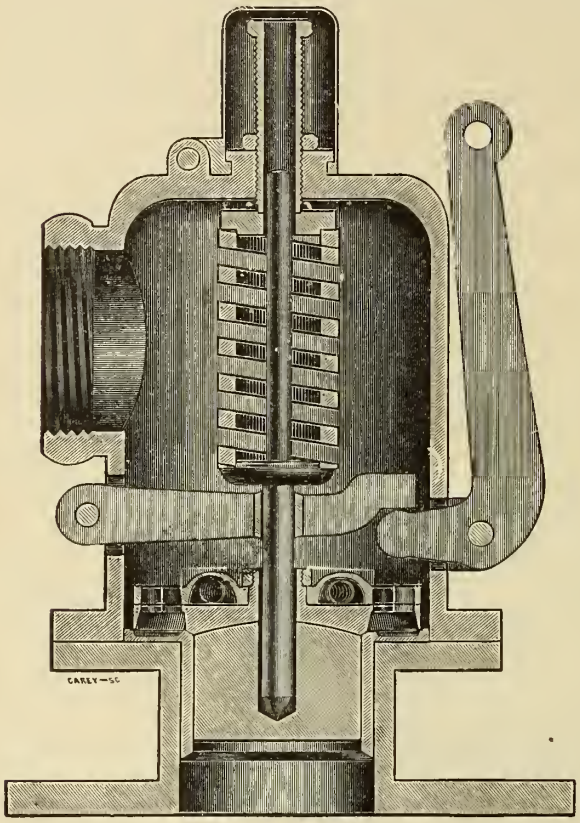


Fig. 43.—Safety Valve for Stationary and Marine Boilers—Interior View.

square feet of grate surface of boiler. For *spring-loaded* pop valves, one square inch valve area for every three square feet of grate surface in the boiler.

Locomotive Pop Safety Valve.

When the pressure in the boiler reaches the predominated point at which

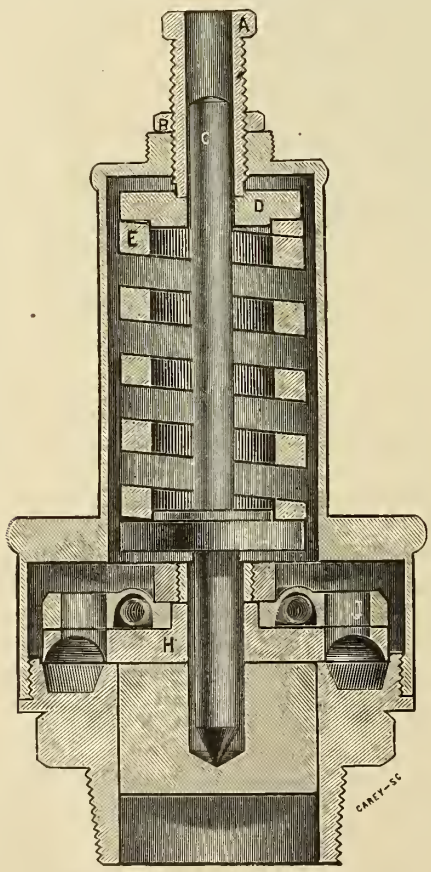


Fig. 44.—Inside View of Locomotive Valve.

the valve H is set to blow, the valve will rise slightly from its seat and allow the steam to escape into the expansion chamber under and around the valve; and, as soon as the escaping steam into this chamber has created a slight pressure above the atmosphere, the valve H will at once be forced upward to its extreme lift when at that point. The steam passing through the inclined holes J will force off the automatic head G, causing a reduction of the increased area and a rotation of the valve until it again reaches its sit, when the automatic head will be forced back into position by its spring E, and the valve is ready for the next operation.

A—Screw to adjust spring to pressure required.

B—Check-nut to hold screw after being adjusted.

C—Spindle.

D—Follower for spring.

E—Spring.

F—Nut to hold adjustable head.

G—Adjustable or automatic head.

H—Valve.

J—Inclined holes in head.

The makers claim it the safest, most reliable, and *only* automatic adjusting pop safety valve, and that its action is such that it will *never stick* on its sit.

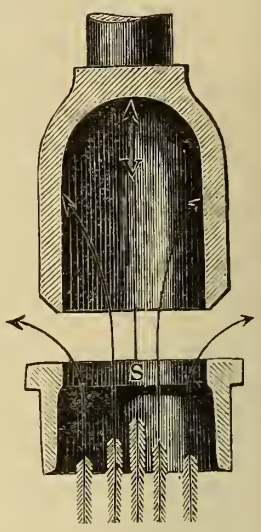


Fig. 45.

Turnbull's Equilibrium Safety Valve (Glasgow, Scotland).

The inventor of this valve claims that it will lift with the slightest increase of pressure, and will close practically at the identical pressure at which it opens. The chief features in these valves are that they are entirely free from all obstructions, such as guides, feathers, etc., in the steam passages to which they are fitted, while the valves themselves are of bell form, as shown in Fig. 45; the arrows indicate that it is supported somewhat on the principle of the hydrostatic paradox.

The valve consists of an inverted cylinder, or bell, chamfered at its lower end, and resting on a flat surface of small extent (see Fig. 46).

For marine or stationary purposes the form of the valve is as above described, but the valve is guided externally at the lower end by a brass

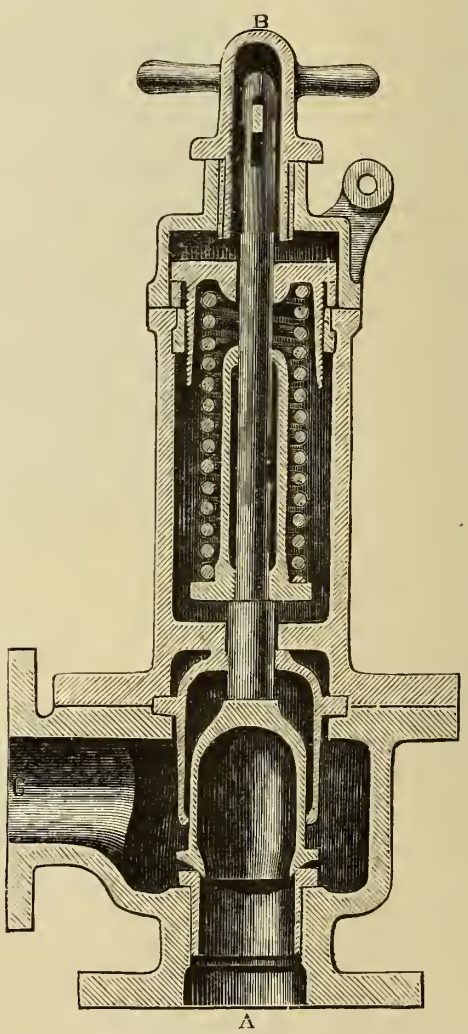


Fig. 46.—Turnbull's Lock-Up, Spring-Loaded Valve.

cylindrical casing, as shown in Fig. 46, this guide having only a narrow surface in contact with the valve. The arrangement of the spring will be readily understood from Fig. 46, and it will be seen that the upper end of the valve spindle is guided by an extension of the spring compression nut.

Disk Safety Valve.

Through the use of the disk the same object is sought to be obtained as by means of the reactionary principle. The disk is usually located below the ground sit of the valve, between which and the disk there is a space

which may be designated as a reduction chamber, for the reason that when the valve proper is forced from its sit by the pressure in the boiler, the pressure in this chamber is reduced, thereby allowing a greater force to act against the lower and inner faces of the disk (which is of a greater area than that of the valve proper) than that acting between the valve proper and the disk, forcing the valve further from its sit.

In valves constructed with disks attached to their spindles, either below or above their ground sit, the disks are of larger areas than the areas of the

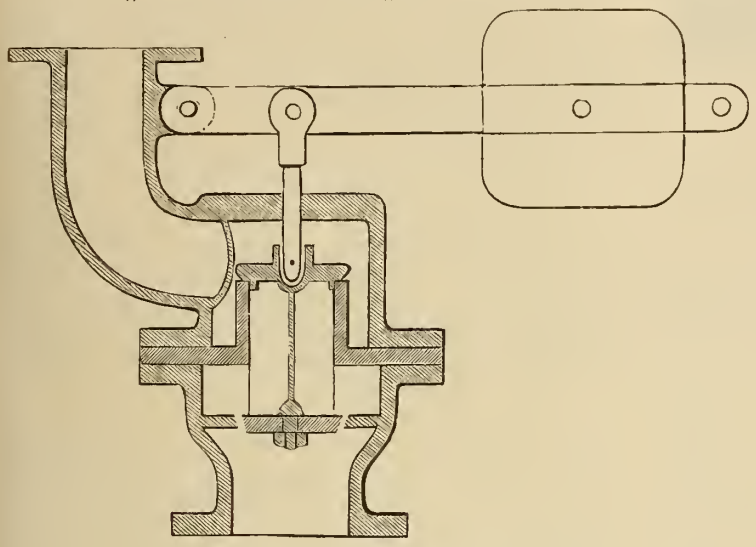


FIG. 47.—DEAD-LOADED DISK SAFETY VALVE.

valve proper, and when attached to the spindles below the ground sits, operate in a recess, which may be termed a "reduction chamber."

The Cockbourne is a fair example of this form of safety valve.

COCKBOURNE DISK SAFETY VALVE.

Fig. 47 shows a section of this valve with a stationary weight, those spring-loaded being the same.

The valve proper is constructed in the usual manner, with feather-edged wings, or guides, extending into the casing. These guides extend some distance below the point where they come into contact with the casing for the purpose of receiving and sustaining the disk, the disk being considerably

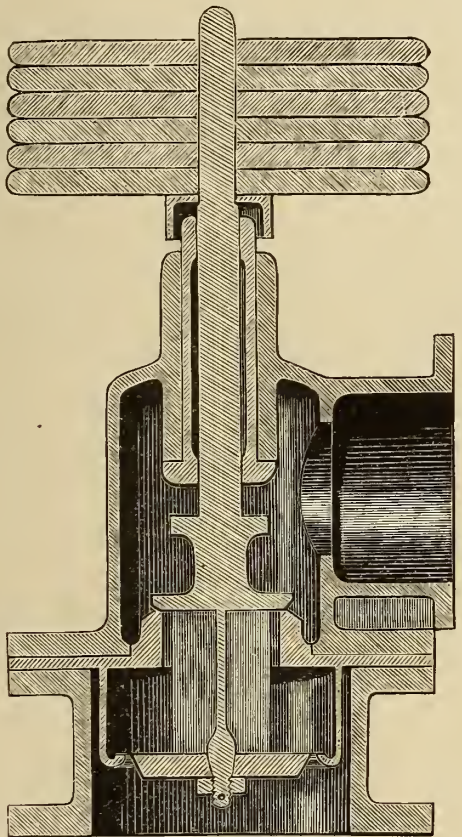


FIG. 48.

larger in area than that of the valve, and nearly filling the lower opening in the casing. The edge of this disk is bevelled. Below the casing, carrying the sit of the valve, and above the disk, is a chamber of considerable area in extent, as shown in Fig. 48.

The result of this arrangement is, that the steam, in its passage through the narrow space between the disk and the casing below the valve, becomes wire-drawn, thereby diminishing the pressure in the chamber upon the upper side of the disk. Consequently the under side of the disk, being exposed to the greater pressure in the boiler, is forced upwards, and a greater lift is thereby given to the valve than that due to the pressure and volume of steam in the boiler. The thickness of the edge of this disk, as well as its form, has much to do with the action of the valve.

These safety valves at the Washington navy yard trials showed no excess at 30 and 35 pounds pressure. Lift, 0.23 inch; area 1.82 square inches. The valve tested at 35 pounds was spring-loaded. The excess obtained at 70 pounds pressure, was one-quarter of a pound. Lift, 0.15 inch; area, 1.18 square inches. This valve was loaded by a lever and weight.

REACTIONARY VALVES.

As the reactionary valves, such as the Adams, Turnbull, and others, of England; the Richardson, Crosby, American, and others, of America, constitute a type which has come into very general favor, and have just been described and illustrated, the construction of these valves is now widely known and a brief *resume* will suffice. The outer edge of the valve is extended to form an overhanging lip, and the simple explanation of its action is, that the steam, in rushing out in the direction of an angle of say 45°, is deflected by the overhanging lip, an upward pressure tending to force the valve further from its sit is produced, and thereby obtain a larger area than that primarily due to the pressure and volume of the escaping steam when acting only upon the area due to the diameter of the valve proper.

It is quite evident, however, that if the steam, after passing the ground-sit of a safety valve, and before it can make its final exit into the atmosphere, is opposed by any means which will act to retard its escape and force it against the valve sit and any overhanging portion of the valve, will have a tendency to force the valve further from its sit than it would if left free.

It is a fact that such valves must expose a larger area than valves where the steam passes unobstructed by such means direct from their ground sits to the atmosphere, in order to discharge the same volume of steam.

In the report of safety-valve tests made at the United States navy yard, Washington, D. C., by a special committee of the Board of Supervising Inspectors of Steam Vessels, September, 1875, is the following:

"Some of these reactionary valves proved very efficient, but the committee are not quite sure that they will prove to be the best in a long run. It appears to the committee that the nicety of the adjustments of parts required by the sharp lines of the stricture, as well as the fact that no one valve can be adjusted to more than one pressure, at least within a very narrow limit of pressure, without extra springs, will cause them more frequently to get out of order than the common lever valve, or some of the disk valves. The action of this construction of safety valve under pressure may be described, in general terms, as *erratic*, *tremulous*, and in some instances, *tumultuous*. It was very difficult to adjust some of these valves twice alike, or to make them constant in their action, and they would not always give the same result under the same adjustment."

COMMON LEVER SAFETY VALVE

The committee say, in regard to the trial of the common lever safety valve (see Fig. 22) as follows:

"*First.* That the diameter of a safety valve is not an infallible test of its efficiency.

Second. That the lift which can be obtained on a safety valve, other conditions being equal, is a test of its efficiency.

Third. That the lift of a safety valve depends upon the velocity and weight of the escaping steam.

Fourth. That the valves with small areas made a greater excess than those with large areas, even when the former recorded a greater maximum of effective area.

Fifth. That two-tenths (0.2) of one inch is the maximum lift to be obtained on a common lever safety valve.

Sixth. That the common lever safety valve, when constructed upon correct principles, employing good material and workmanship, will correctly indicate the maximum pressure of steam in a boiler, and, when suitably proportioned, relieve the same of all excess."

They further say, that "in the arrangement of safety valves for any boiler, or set of boilers, the committee is of the opinion that a number of valves (where more than one is required) is preferable to one valve with a large area; and do not believe it advisable to employ a common lever valve, with either a beveled or flat sit, of more than 10 square inches area. According to these experiments, two such valves will discharge *four thousand* pounds of steam in one hour, at all pressures from 20 to 100 pounds per square inch; and if the results deduced from the experiments are taken as conclusive, the rule of proportion is all that is required in arranging the areas necessary to discharge the weights of steam generated, without any reference to its pressure."

The following rule is the nearest approximation these tests will warrant:

Weight of water evaporated in one hour, multiplied by 0.005; or,

An area of 5 square inches, up to 1,000 pounds evaporated per hour.

An area of 10 square inches, from 1,000 to 2,000 pounds.

An area of 20 square inches, from 2,000 to 4,000 pounds.

An area of 30 square inches, from 4,000 to 6,000 pounds.

An area of 40 square inches, from 6,000 to 8,000 pounds.

ANNULAR SAFETY VALVES.

These valves are constructed with two ground sits upon an annular opening, and allowed an external and internal escape for the steam. Some annular valves have attached to the valve or casing an adjustable lip, for the purpose of controlling the exit of the steam. The object sought in the construction of this safety valve is *an increase of area.*

(To be Continued.)

CANADIAN ELECTRICAL NEWS AND STEAM ENGINEERING JOURNAL

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CHAS. H. MORTIMER,

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Correspondence is invited upon all topics coming legitimately within the scope of this journal.

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WE have received a sufficient number of enquiries from engineers concerning the situation referred to in an editorial paragraph in last issue, to satisfy us that the ELECTRICAL NEWS is widely read. Several of these enquiries came from British Columbia readers.

SIX months ago the City Council of Montreal took note of the fact that for many years a considerable sum had been paid for insurance on city buildings, while there had been little or no damage from fire, and decided to allow its policies to lapse. The unwisdom of this action is now apparent in the recent destruction of the Bonsecours market. The Council have decided to again insure.

A SMALL vessel, the hull of which is made of polished aluminum and the machinery driven by a naphtha engine, has been built at Zurich. Only the hull is of aluminum, yet the use of that metal instead of steel caused a saving of 35% in weight. The polished surface diminished the friction, and a greater speed was obtained than from any steel or wooden vessel of same dimensions and power.

THE vice-presidency of the Great North Western telegraph Company, rendered vacant by the promotion of Mr. H. P. Dwight to the presidency, has been conferred upon the Hon. Adam Brown, postmaster of Hamilton. There is no reason to doubt the wisdom of the choice. Mr. Brown has had a long business and public career, and will give to the discharge of the duties of his new position the benefit of matured judgment.

WE do not suppose that our City Council's committee will find out much that was not known before they started on their trip to inspect electric street railway systems, but if it results in the City Council arranging that electricity must be used at once, few of the citizens will grudge the cost of the trip. The storage battery system seems about as successful as putting the horses inside the car and making them run a treadmill to drive the car.

A WRITER in the *Stationary Engineer* describes a boiler explosion which occurred in December last, and declares that "after a thorough examination of the wreck and some thought on the subject, I have come to this conclusion, that the cause of this explosion was electricity generated in the boiler and exploded the same as lightning." If electricity can be generated in a boiler and exploded, it surely can be generated and *not* exploded. Our friend should prosecute his thinking. If he can show electric companies how to generate the electricity without the use of the steam engine and the dynamo, his fortune is made.

THE Royal Electric Company has determined by the construction of dams, etc., to utilize the water power of the Richelieu river at Chambly for the supply of light and power to the city of Montreal. The planting of poles and stringing of wires to conduct the current will shortly be commenced. The Company expect to be able by this means to deliver 20,000 h. p. in Montreal, which would be sufficient to operate 200,000 incandescent lights. The Royal Co. by means of this improvement will be in a position to supply light and power at the cheapest rate, and to outbid competitors for the city lighting when their present contract shall have expired at the close of 1893.

A BOILER Inspection and Registration Bill is now before the British House of Commons. The object of the bill is said to be to prevent boiler explosions and save human life. The bill, if it passes, is to come into operation on the 1st of July, 1893. It provides for compulsory annual inspection and registration of steam boilers. It does not provide for Government inspection. Each boiler owner must select his own inspector, and is held responsible for the competency of his inspector. Boilers used exclusively for domestic purposes, in private houses, locomotives and boilers in sea-going vessels are to be exempt from the operation of the bill. The bill seems to be a fair and reasonable one, but is sure to be well discussed before allowed to become law.

THE rate of combustion of coal in a boiler furnace varies very much, but seems to be on the increase. Pressure of steam has increased, piston speed has increased and the tendency is to

force everything to its utmost. The coal consumed per sq. foot of grate surface is a measure of the intensity of the fire used. In many cases with natural chimney draught it ranges from 10 lbs. per hour to 20 lbs. per hour. With forced draught it has been as high as 120 lbs. per hour. It is evident that there must be a limit, as the formation of ashes and clinkers increases rapidly, and with a rapid combustion the grates would soon need cleaning off. We are not aware of any experiments to determine what the limit of practical work in this matter is, but we should judge that a furnace using 200 lbs. of coal per sq. foot per hour would be found very difficult to keep in order. The production of heat in nature is still a long way ahead of any human contrivance. Some of the most careful experiments to determine the amount of heat radiated from the sun show the startling result that it is equal to a combustion of nearly 2,000 lbs. of coal per sq. foot per hour. The sun heat is certainly not produced by coal combustion, but the spectroscope proves that many of the gaseous elements are the same as are found in our coal fires. What a change in steam boilers if furnaces could be got that would give results equal to the sun's rate of heat production, and as little trouble with ashes and with clinkers !

ELECTRIC railway business in Canada promises to be very brisk the present year. The electric railroad was given its first test in Canada in some of the smaller cities and towns, and on suburban lines. Having demonstrated its practicability and advantages over existing methods of transit, the cities of Hamilton, Toronto, and Montreal have determined to adopt it. In Hamilton the contract for construction and equipment has been let, the power house is in course of erection, and track laying is under way. In Toronto, matters are being delayed to give opportunity to dispel from the minds of the mayor and some of the aldermen the theory of the "storage battery" as compared with the trolley. We imagine the theory has about dissolved into thin air, and it is therefore to be hoped the change of system will at once be made. The news comes from Montreal that the street railway will be converted to the trolley electric system at once ; it is expected that the change will be effected by the 1st of September. In addition to these larger undertakings, there are also a number of smaller ones in process of development. For the carrying out of these enterprises a large amount of electric and steam apparatus will be required, the cost of which will run into the millions. To us it seems a matter of regret that Canadian electrical manufacturers do not seem to have made preparations to make the greater part at least of this apparatus and reap the profits which will probably find their way into American pockets. There is also the benefit which would result to our workmen from the making of these goods in Canada. We see it stated that an American firm has been given the order for cars for the Hamilton road. We hope that such is not the case. The cars made for the Ottawa road by Messrs. Patterson & Corbin, of St. Catharines, seem to us to meet every requirement, and we can therefore see no reason for going abroad for what can be satisfactorily produced at home.

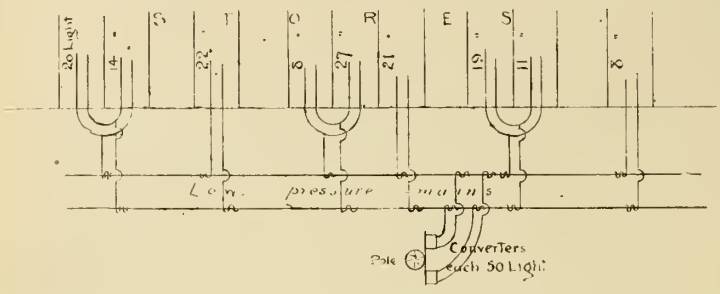
ECONOMY in the operation of electric apparatus for the production of light and power, should be of primary consideration with managers or superintendents, not such economy as would detract from the service that is required to be given, but such as will make the plant a paying one, if it is possible at prices obtained to so make it. By economy in this relation we mean looking closely after the small leaks and wastes that are bound to exist unless the most stringent means are used to prevent them. It may be the oil, the cotton waste, or even the coal pile. It no doubt is a difficult matter in some cases to locate small and sometimes even large leaks, so well are they covered up ; not that it is our intention to say that deception is practised in covering them up, but only to point out that employees get into a rut in performing their daily work. By close observation small savings can be made that in the long run amount to a considerable sum in dollars. It may be that the waste box is patronized by the cleaner to too great an extent, and waste thrown into the coal hole to be burnt that would do considerable more duty were the fact pointed out to him. This also applies to the engineer and his assistants as well as to the dynamo cleaner. Then there is the oil question—a gigantic one with some stations. Let us look at it from the point of economy, and see if there are not some leaks that could be effectually stopped. Have you an oil filter ? and does it do its work well ? If not, by all means get one as quickly as possible ; again, have you some of your dynamos throwing oil around and acting as though their whole duty was to see how much good oil they can manage to cover a certain part of your floor or wall with in a limited time ? if so, be sure to stop it at once. If necessary, have the journal rebabbitted and made to fit the shaft, for ten chances to one that is the cause of it ; then cast your eye occasionally on the oil cups, and place your hand on the bearings that your man is supposed to attend to and keep in good shape, for be it known that one of the worst sources of waste in lubricating oil is caused by a hot or heated journal and the consequent amount of oil that must be put through it to bring it back to its normal state again. While on this question of oil we would like to say that it is poor economy to use a cheap article—cheap only in price per gallon, dear when the amount consumed is taken into consideration. This applies equally to cylinder, engine, or dynamo oil—they must all be the best to get good and economical service. Bad oil as well as inattention will cause hot boxes with consequent cutting of the babbitt, necessitating the expenditure of good money in time and material to make right again, all of which should be added to the price per gallon of the oil used. Last, but by no means least, is the coal pile, for if there is one part of an electric lighting plant that requires greater care than another in order to secure economical results, it is the steam plant. Economy there consists in having good firemen, men who know just when to put more coal on their fires, and just where to put it, and how much to put ; to clean out the boilers frequently and use some good article to prevent scale from adhering to the shell and tubes, and who know how to keep steam up to a pressure just inside of the blowing-off point. It means a drop of from 3 to 7 lbs. in pressure before a valve will close down after it is once lifted by the pressure ; that means that a considerable lump of your coal has been burned to no purpose. See to it also that steam pipes around your boilers and those running to the engine have no leaky joints, and that they are well covered with a good fire-proof non-conductor—one which will allow you to place your hand on the outside and suffer no inconvenience thereby, even if there should be a pressure of 100 lbs. of live steam on the inside of the pipe. Such things are made, and we have come across them more than once ; they should not be clumsy, and in no case greater than 1¼ to 1½ inches in thickness, except where they are used for covering the outside of a boiler. Another point in this connection is to have your steam pipes sufficiently large to cause no wire drawing of your steam, and your exhaust pipes large enough to let the spent steam reach the air without any choking, thereby causing back pressure on your engines and the consequent waste of so much money in coal to force it out. In conclusion we may say that just such faults as are enumerated above have all come under our direct observation at times, and the wonder sometimes has been "how came it so."

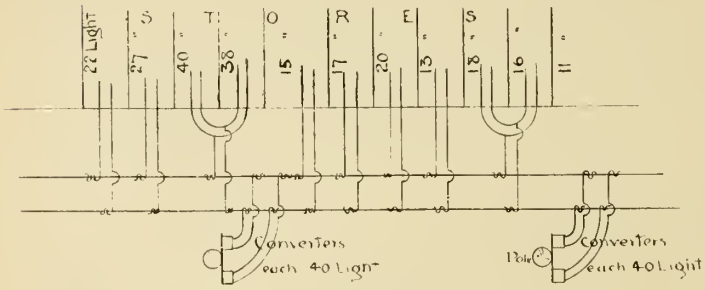
THE BLOCK SYSTEM OF DISTRIBUTION.

IN the distribution of electricity for store lighting by means of converters, the practice is usually to place a converter on the house front or on a pole close by for each individual store, or at the most for two stores adjoining one another, but this is being superseded by a system of block distribution either from one central point or pole, on which converters are erected to supply the whole block, or if there is a large number of lights in any one block which would require mains say of 000 or 0000 capacity to carry the current, they can be much reduced in size by having two central points of feeding from converters to the same set of mains, in which case the converters are best located at about a quarter of the block's length from each end. This also is an advantage, in that a pole to carry converters for say 200 lights, would require to be a veritable mast in thickness, on account of the enormous weight contained in the converters, whereas with the load (in weight) divided between two poles, it only needs one of ordinary thickness to carry them ; the different shops or stores are then fed from these mains. This is decidedly advantageous in another direction, viz ; that now it is possible to operate say 200 lights from a converter capacity of not more than 150, as there is seldom more than that number in use at any one time out of the 200, and if there should be an occasion when the

entire number would be lighted at once, the converters will carry a temporary overload of 30 to 50 per cent, if they are of proper construction and reliable make, in contrast to which, if each store was supplied from its own individual converter the probabilities are that the capacity of the converters totalled up in lights, would reach well into 300. It is evident then that the loss on converters at little or no load would in this case greatly exceed that in which the capacity of converters in lights is 150. Then again it is a well established fact that there is less constant loss in proportion by using few converters, instead of a number of small ones to do the same work.

To illustrate more fully what we wish to convey in this block system of distribution we append two outline sketches, the first





of which is the one centre of distribution spoken of above, and the second the two centres. By referring to the diagram it will be seen that two fifty light converters connected in multiple will supply mains from which 150 lights, as wired, can be fed to the stores; and in like manner, from 225 to 250 lights can be operated from four 40 light converters connected in multiple with the one set of mains at two different points, the supply wires being dropped off at any point desired. Of course the mains must be of such a size that there will be an even drop, or loss in voltage all over.

THE TELEPHONE IN CANADA.

We print below some interesting statistics which we have gathered concerning the growth and present extent of the telephone industry in Canada. By comparing these statistics with those of other countries it will be seen that we occupy an enviable position, both as regards the extent and efficiency of our telephone service, and the moderateness of the price at which it is furnished:

The telephone rentals charged in some of the principal cities of the United States are as follows:

New York	$240
Boston	200
Chicago	125
Philadelphia	100
St. Louis	100
Cincinnati	100
Buffalo	50 and five cents per call.
Kansas City	72

In the whole of the United States the average cost per connection per subscriber varies from 2 to 14 cents.

In London and Paris the rates are $100.

The following table will give some detail of the rates charged in Canada, the average rate being $31:

Size of Exchanges.	Rate.	Cost per call.	Average No. of calls per day per subscriber.
Under 100 subscribers	$20	.016	4
100 to 200 "	25	.0163	5
200 to 500 "	30	.016	6
500 to 1000 "	40	.014	9
Toronto, 3965 "	45	.012	11¾
Montreal, 5872 "	50	.013	12¼

The use of the telephone in Canada is an evidence that the rates charged are but reasonable. In Great Britain there are 167 telephones in use for every 100,000 inhabitants; in the United States 350 telephones for every 100,000 inhabitants, and in Canada 540 telephones are in use per 100,000 inhabitants.

In Paris, where the telephone is under Government management, and service is furnished as cheaply as possible; there are but 4.2 telephones in use per 1,000 inhabitants; in London, England, where the Government controls the patents and has been liberal with its licenses there are but 1.5 per thousand in use; in Vienna there are but 5 telephones per thousand inhabitants; and in Berlin, where the use of the telephone is supposed to be exceptionally large, there are only 17 per thousand, while Montreal has 25 instruments in use per thousand inhabitants.

The number of telephones in use in Canada is greater in ratio of population than in any other country, and this because of the lower rates charged. In 1880 there were only 2,100 subscribers to the Bell Telephone Company, while to-day there are 26,212.

As an evidence of local growth we give a schedule of the number of subscribers in 1880 in fifteen Canadian cities, and the number of subscribers in those cities to-day:

	1880.	1892.
Montreal	312	5,872
Toronto	353	3,965
Hamilton	181	1,160
Quebec	124	1,011
Halifax	87	955
Ottawa	230	942
London	104	805
Winnipeg	35	798
St. Johns, N.B.	116	617
Brantford	33	314
Guelph	11	226
Windsor	22	205
Woodstock	27	186
St. Thomas	28	173
Cornwall	10	67

The business is still largely experimental. When the value of the telephone first began to be appreciated (between 1878 and 1880) the public and cities welcomed it, and were as anxious to grant facilities as they are to-day prompt to refuse them. At that time it seemed as though every city took pride in having as many poles as possible, and in one notable instance the city gave permission to erect poles in its streets provided they were placed in every street, or in the words of the contract, "the city shall be fully poled." Construction was then relatively cheap, but as the number of wires increased, larger and vastly more expensive poles were erected, and they being finally overladen with wires, the introduction of cables became a necessity. These again were experimental, and the companies hardly got their lines in cables before defects in the old and improvements in the new, compelled their abandonment for other forms. Hardly had a standard been reached in aerial, grounded circuit cables, when the introduction of electric light, electric railway and electric power wires made another change absolutely necessary, since the old grounded wires were rendered useless by the induction from the electric light and power wires. This, by doubling the number of wires, again overloaded the poles, the height of which had reached its limit, bringing about another change, namely, underground construction. Here again everything was novel and experimental. Hundreds of different forms of conduits and cables were brought forward for purchase by the telephone companies, only to be tried and eventually abandoned. This work seemed for a long while to resemble the contest between big guns and iron-clad ships. The companies no sooner procured a cable which overcame the electrical difficulties consequent upon underground work, than some element in the conduit came to light which destroyed the cable. Many of these systems have been abandoned, both conduit and cable being a total loss to the companies, until now both cable and conduit have become so expensive that all over the world, with the exception of Canada, it has been necessary to nearly double the rentals. The cost in Canada of some of the underground conduits when equipped with cables will be nearly $80,000 per mile, and this expense no company would be warranted in incurring unless they were quite sure that they had the field to themselves.

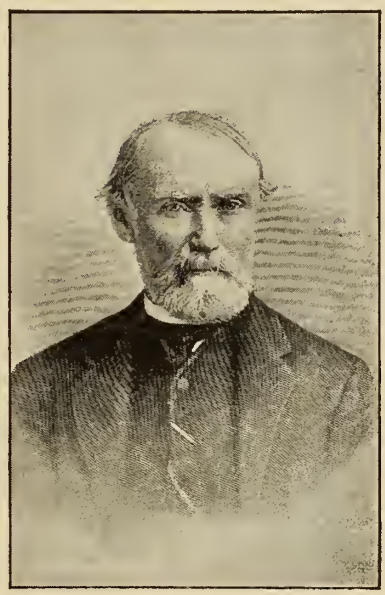
The office equipment has changed as often as the line construction, and it is safe to say that the most expensive part of the apparatus (switchboards and magneto bells) has been wholly changed at least four times within the last twelve years. The expense of this apparatus has increased in the same proportion, until the cost of equipping an exchange with multiple metallic circuit switchboards of the latest pattern, with a capacity of 3,000 subscribers, will be in the neighborhood of $200,000, in addition to the cost of the lines and the apparatus at subscribers' stations.

Another very serious source of loss to the companies is the frequency of the sleet storms, which have in many instances totally wrecked their plant and rendered entirely new construction imperative, without any increase of revenue. The storm of the 11th March, 1892, in Ottawa, caused a loss to the companies, in poles and overhead wires, of probably between $20,000 and $30,000, all of which has to be met from surplus revenue.

Certainly these figures are sufficient to convince any disinterested person that the telephone companies, possessing a property of a very hazardous nature in itself and subject to continual change, must be able to earn not only their expenses and their dividend, but a large sum to be placed to reserve in order to meet contingencies.

THE NEW PRESIDENT OF THE G. N. W. TELEGRAPH CO.

HARVEY PRENTICE DWIGHT was born in Belleville, Jefferson County, New York, in the year 1827. He received his early education at a small country school house in this district, and at the age of 14, with but 50 cents in money and the clothes on his back, left home to seek his fortune, walking ten miles to a small village, where he procured employment in a general store, and where he remained for a space of three years. At this period telegraphy was in its infancy in Canada, and held out bright inducements for young men to enter its service. He left his employment in the store and sought and secured a position in the telegraph office at Oswego. After learning the art of an operator he made application for employment with the Montreal Telegraph Company, then commencing operations in Canada. He was first stationed at Belleville, Ontario, where the first telegraph office was opened in August, 1847. Here he remained a few weeks, and was then transferred to the head office at Montreal, where he remained for nearly three years, and was then sent to Toronto to take charge of the business. The company at this time had a line of one wire between Quebec and Toronto, a distance of about 500 miles, and some 12 or 15 offices. Extensions were rapidly planned and carried out under Mr. Dwight's direction throughout the Province of Ontario, and he was made Western Superintendent of the Company. In 1881 a consolidation of telegraph interests took place under the charter of the Great North Western Telegraph Co., through the instrumentality of Erastus Wiman, who became President of the Company, Mr. Dwight being appointed General Manager of the consolidated interests. Four years ago he was elected Vice-President, and on the resignation of Mr. Wiman on March 30th last, appointed his successor as President, and thus became the most prominent personage in telegraph circles in the Dominion.



MR. H. P. DWIGHT, PRESIDENT G. N. W. TELEGRAPH COMPANY.

The Great North Western Telegraph Company is the most extensive and far reaching telegraph enterprise in the Dominion, controlling about 40,000 miles of wires and nearly 2,000 offices. Its ramifications extend throughout the provinces of Ontario, Quebec, New Brunswick, Manitoba, and parts of the States of Maine, New Hampshire, Vermont and New York. The completeness of the system is due in great measure to the broad executive ability, foresight and judgment of Mr. Dwight, and for cheapness and efficiency Canada may be congratulated on possessing a system of telegraphs in the Great North Western Company second to no country in the world.

A POPULAR DESCRIPTION OF THE MAIN PRINCIPLES OF THE DYNAMO.

BY JOHN A. GRIER.

THE collection of electricity, or its generation as it is often called, is no more or less mysterious than the generation of heat. For those who make no pretensions to understand the governing principles underlying the generation of electricity by a dynamo we present the following brief explanation which we hope may be easily grasped.

Perhaps every reader has played with a common horse-shoe magnet. No one can have one in his hand even for a few moments, without noticing that the small piece at the two ends, called the armature, when brought close to these ends, not allowed to touch them, is affected by some invisible influence which tends to draw it towards these ends. This mysterious influence is called magnetism. On laying a horse-shoe magnet on a piece of a paper placed in a horizontal plane and loosely sprinkling iron filings around these ends, it can be seen that there is an apparant current of influence projecting into space from the ends and running across the space at the open ends of the magnet. These imaginary projections or currents of this mysterious influence are called "*lines of magnetic force.*" Here we have the magnetic force and the next thing is to get the electricity. By moving an armature across these lines of magnetic force at the ends of a magnet we find it requires an expenditure of energy. In the case of a dynamo we obtain this energy from steam, water-power or some other source. The generation of electricity is as easily understood as the method of getting power by a steam engine. It is known that if we take a conductor of electricity, like a common copper wire, and by any means cause it to move through lines of magnetic force in a certain direction that *electricity will be developed* in this conductor. No one pretends to explain why. This is the whole mystery of the dynamo with all its astonishing possibilities in the service of man.

We know how to do it but are as much in mystery about the reason Nature acts in this way as we are to explain why an apple goes down instead of up when rolled from your open hand.

A dynamo consists principally of two parts, one of which is a large mass of soft cast or wrought iron called the magnet and the other part is called the armature. Soft iron does not remain permanently as a magnet except to a very slight degree. However, some magnetism always remains stored in iron. There is a germ of magnetism great enough to be easily and quickly increased when properly handled by well-known methods. The revolving shaft, as seen in the ordinary dynamo, is called the armature. The armature is usually constructed by having hundreds of insulated copper wires in it and is made to revolve at a high velocity by some mechanical force, such as steam. Suppose this speed is 1,000 revolutions per minute, which is not unusual, and that we have 500 wires on this armature, then we will have, as the armature revolves, what would be equivalent to a single wire cutting across all the lines of magnetic force of 500,000 times each minute. The magnet generally entirely surrounds the armature and these magnetic lines of force are shooting through the armature in a continuous stream at an inconceivable velocity. All the wire conductors on the revolving armature as they move these lines of magnetic force are constantly picking up their little share of electricity and unloading it by means of ingenious mechanical devices connecting with the conducting wire that leads from the dynamo, and receiving the returning electricity on another wire leading into the dynamo.

One of Nature's wonderfully mysterious laws causes soft iron to become magnetic when surrounded by a current of electricity. In the ordinary dynamo this law is of the greatest utility. As the electrical current is being collected by the revolving armature, it is led around the magnet and thus the magnetic germ is quickly changed into a mighty force, again feeding the armature which transforms it from magnetic to electrical force. The average reader may not choose to seek any farther into these mysteries, but may be satisfied to understand these main principles that underlie the mechanical generation of electricity by a dynamo. Stated more concisely, permit me to repeat. A conductor of electricity if made to pass through a magnetic current in a certain direction will have a current of electricity generated in this conductor. A dynamo consists mainly of a magnet and an armature, one of these must be put in motion by some outside force in order to generate electricity, then these small portions of electricity as it is generated are led off, concentrated for use. Thus the generation of electricity by a dynamo is a happy combination of these two closely related, omnipresent forces, magnetism and electricity, brought about by the expenditure of energy derived from some other source. It is not a new creation of energy, but only a change in its form more convenient for our use. Instead of a belt or gearing as in a steam engine or a water-power, we can convey this form of energy far more economically by a wire to the place we wish to use it to produce motion, heat or light. The dynamo is not a substitute for the steam engine or water power, but is simply an auxiliary. By its use there is always a considerable waste of energy, but we get the energy we use, in the most economical way, to the place where it is most required.—*Mechanical and Electrical Progress.*

WORK AND POWER AS MEASURED BY THE STEAM ENGINE INDICATOR.

THE following paper on the above subject was read by the author, Capt. Wright, at a meeting of Montreal Branch No. 1, C. A. S. E. Introductory to the paper, as printed below, the author gave a brief history of the invention and improvement of the indicator:

I will now proceed to an investigation of the revelations of the indicator diagram. First, it is simply a record of the pressures against one face of the piston during a complete revolution of the crank pin. It goes no further; the rest we must do ourselves. I am aware that there are able engineers, men fit for any position, intelligent and reading men, who yet consider the whole thing a humbug, and look at indicating an engine as mere playing with a toy. To do them justice I will defend them. They have never given the subject a serious thought, and during their education as engineers, the instrument was not in use. I have often told them that if James Watt, Wm. McNaught and Dan Gooch found it necessary to invent instruments to tell them what was going on in their cylinders, perhaps it would do us no harm to follow their example.

I am aware that the standing of the indicator has been injured by quacks and prodigies—men who will practically tell you, that what they don't know is not worth knowing. It is plain that they have not learned the first lesson in indicator practice, that we know very little about steam doing work in a cylinder, and it is advisable to be modest. But it is said that nothing was made in vain, and so the indicator quack performs the important mission of bringing the instrument to the notice of the public. The mechanical terms, "Work," "Power," "Energy," which must be used in our present enquiry, had better be defined. These words have a technical meaning in engineering which cannot be found in our common dictionaries. "Work" is motion against resistance. A resistance is overcome, motion takes place, work is done. "Power," as understood by the modern engineer is simply the rate at which work is done; thus, the hammer of a pile driver weighs 3,000 lbs. and it is lifted 30 feet high; here a certain amount of work is done, viz., 3,000 lbs. lifted 30 feet, or its equivalent in foot pounds, 9,000 lbs. lifted 1 foot high. So far we can say no more. But when I say that 3000 lbs. is lifted 30 feet high in half a minute, a rate of work is named. And these three factors, namely, amount of resistance, distance moved, with the rate or time it was done in, is the "power" which is generally expressed in units of 33,000 lbs. lifted 1 foot high in a minute called a horse power. But it must be remembered that this so called h. p. is only a convenient unit. It would be absurd for the Grand Trunk or C. P. R. to express distances between stations in inches. The figures would become so large, that we could not compare or comprehend them. In consequence a unit of 63,360 inches is used, called a mile. It is just so in our business. The units of work done by engines pile up so fast, that a unit of 33,000 foot pounds per minute is used, which brings the amount within our comprehension.

The engineering "Energy" is the ability to do or the capacity for performing work. We now wonder how the old engineers, managed to express their ideas without this word, for its use by engineers is quiet modern. They were in the habit of coining some word from Latin or Greek, with the result that they confused themselves, and other people could not find out what they meant. Go to the Bonaventure station at 4:30 in the afternoon, and you will see several locomotives, standing in front of trains. They look quiet and peacable—they are doing no work. Look in the cab, you may see the finger of the gauge pointing to 160. We have the idea there is something about her quite different from what would be, if the finger stood at 0 on the gauge. In the state she is in, she is possessed of energy; she is capable of doing work, and the amount can be determined. In this case energy exists, but for the time being is not used, it is at rest. I imagine the train going along at 40 miles per hour; steam is suddenly shut off; she keeps on going; there is now no force drawing her along; it is the energy stored in the train by the work previously done by the engine. In this form it is energy in motion, and in proof that it is capable of doing work, look at the destruction caused by a collision.

The mechanical idea of work covers every case of resistance overcome, whether it be the sawing out of a board in a mill, or the breaking of it up in a collision. And so in the case of a fly wheel, energy is stored in the early part of the stroke, and restored in the latter part. Build a dam across a river—the impounded water is a store of energy; work is capable of being done there. A boiler under steam is a store of energy; no work is done by the boiler except in case of an explosion. The small matters of every day have their examples. I wind up my clock at night; in doing so I have done work; by raising ten weights I have stored energy in the weight. It is capable of doing work in driving the clock for the next 24 or 30 hours. In all the cases mentioned, the amount of work that can be done is in proportion to the stored energy, either at rest or in motion, and it can be computed. From this standpoint an indicator diagram is a diagram of energy. Give me the scale of the spring with which it was taken, the diameter of the piston and the length of stroke, and I can compute the work done per stroke. Give me the number of revolutions per minute and I can compute the power, or the rate at which work is done.

There are many distinct classes of engines—slide valve, with lap or without it, with a governor and without; some have cut off valves on the back, some cut off outside of the steam chest. Then there are automatic engines, condensing and non-condensing, compound engines with two, three and four cylinders. Each class of engine, if in good working order, makes a diagram with characteristics of the class to which it belongs. A glance is generally sufficient to tell the family it came from.

In the multiplicity of peculiarities and forms observed in diagrams, it would be impossible to take notice of all, I think one is enough, and I have selected one of the Corliss class: it may be a Brown or a Green, or any other of the automatic family, with a cylinder 16″ diameter and 42″ stroke, making 70 revolutions per minute, a piston speed of 490 feet per minute. This engine is a common size, neither very large nor very small, with a fair speed of piston. Another reason why I selected this size cylinder and speed of piston is to avoid fractions, which if any, required constants, are so small in this case that they can be neglected without any sensible error.

In determining the performance and efficiency of an engine by means of an indicator, it is usual to calculate certain quantites, called "constants," which save a great deal of after time and trouble. A constant is a reality, it is the result of a calculation carried out to a certain point, which point is common to all engines of that size piston, and speed of piston. A power constant, for our selected engine may take this form. What is the power of a 16″x42″ engine, with a piston speed of 490 feet per minute and 1 lb. M. E. P.? Work this out in the usual way—multiply the piston area by the M. E. P. and by the piston speed, divide the product by 33,000. The quotient is 3, which is the h. p. with one pound M. E. P. This is the power constant in this particular case. Look seriously at this for a few moments, and you will perceive that if the M. E. P. was doubled, you would have double the power; if the M. E. P. was trippled, you would have three times the power; of course all other factors remain the same. If you have doubts of this, work it out, and you will find it is true.

It is then established that the M. E. P. multiplied by 3 is the h. p. of any diagram taken from a 16″ cylinder having a piston speed of 490 feet per minute. It is sometimes best to know exactly what we are doing. If anyone here works out this constant, he will find that the real constant is a three-hundredth part less than 3, which I have dropped as insignificant and of no consequence. An extra piston speed of 20 inches per minute would bring the constant up to 3. Looking at the thing from a money point of view, a tenant rents 1 h.p. from our 16″ engine at the rate of $75 per year. In working up the h.p. of the engine the constant 3 was used; our tenant is paying one-twelfth of a cent too much per day—an amount of no consequence in such a bargain.

Another constant much used and a powerful weapon in the hands of the engineer, is known as "piston displacement," or the volume swept by the piston while making one stroke, or one revelution, or during one minute or one hour—or for that matter, one day if you wish, but for good reasons it is customary to count it by the hour. A moment's thought will convince any engineer that at work the cylinder and piston of an engine are actually performing the functions of a meter. She discharges every stroke a certain volume and weight of steam. The volume is constant, but the weight varies according to the pressure

existing in the cylinder at the end of the stroke, or the "terminal pressure," as it is called. The amount of both of these factors can be determined as easily and accurately as the cubic contents of a box, or the weight of a bar of iron. It is generally advisable and always beneficial to know with precision what is going on around us—a fly wheel turns around ; a piston goes backwards and forwards, but that is not all ; let us see what is really being done in our 16″ cylinder, with a piston speed of 400 feet per minute, and only in relation to the simple idea of distance travelled by the piston. The piston travels 490 feet per minute ; in sixty minutes or one hour it travels sixty times 400 feet, or 29,400 feet, and in a working day of ten hours duration, ten times that amount, or 294,000 feet—a number too large for us to grasp—I therefore divide this distance expressed in feet by 5,280, the number of feet in a mile, and get as the distance travelled by our piston in a working day of ten hours, 55 miles and 3,600 feet. To get a step further, in a year of three hundred working days of ten hours each, our piston has travelled in the cylinder a distance of 16,704 miles. Some may think that such things as this is merely the gratification of idle curiosity, but the facts that I have stated have a bearing on our investigation this evening in a manner not suspected by the fault finder. Our 16″ cylinder has a piston area of 201.062□″, and moves 42 inches each stroke. The displacement of the piston or volume of steam passed through the cylinder each stroke is 201.062 × 42, or 8444.604 cubic inches ; in two strokes, or one revolution, 16889.208 cubic inches. This number is getting incomprehensible already, so I will reduce it to cubic feet by dividing it by 1,728, the number of cubic inches in one cubic foot, and get for answer 9.7738 cubic feet, being the volume displaced by the piston during one revolution. But our engine makes 70 revolutions per minute, therefore the revolutions made per hour is 4,200. This number multiplied by the piston displacement per revolution gives me 41049·96 being the piston displacement in cubic feet during one hour's work. You will perceive that this is also the volume of steam that has passed through the cylinder during that time. The number 41049.96 is known as the displacement constant of one of our 16″ engines making 70 revolutions per minute, and I shall use the whole number 41050 as being sufficiently close for the purpose.

Armed now with our power constant of 3, and displacement constant of 41050, we are in a position with the assistance of an indicator to quickly and accurately determine the amount of work done and the cost, whereby we can compare the performance with other classes or sizes of engines and also discover defects, if any exist, and point out the remedy.

You all know how indicators are attached to cylinders, so I will not occupy your time with that. As a general rule, the shorter the pipe and the fewer the elbows, the more reliable is the diagram. Then some form of reducing the motion is necessary to bring the stroke of the piston within the limits of the instrument. The swinging lever and the pantograph are examples of that. Nothing in indicator practice appears to have given engineers so much trouble and concern as a true reducing motion that could easily be applied to any engine. Differential pulleys, spring pulleys, inclined planes, levers, screws and pantographs have all been used. It appears to me that the proper solution of the question is to have every builder of engines put on as a permanent fixture some approved form of reducing motion.

I will now suppose that we are ready to take a diagram. The pipes have been blown through to clear them of dirt, the instrument is in place and warmed up, a card is in place on the paper drum, a true reducing motion is in place and at work with a string of the proper length communicating motion to the paper drum, and the instrument is in free communication with only one end of the cylinder. After being sure that all is right and in good working order, apply the pencil to the paper on the revolving drum with light pressure during at least one complete revolution of the crank-pin. Next shut off the steam from the instrument in the proper manner so that atmospheric pressure is on both upper and lower faces of the piston ; put the pencil on the paper again and draw the atmospheric line ; then unhook the string ; the drum stops revolving ; take off the card and you have a diagram of the pressures which existed against the face of the piston then in communication with the instrument.

I wish particularly to again call your attention to the fact that an indicator diagram is neither more nor less than a record of pressures, and from that record we perceive at once the state of affairs in that end of the cylinder. Thus if the steam port was not open at the beginning of the stroke the pencil does not rise ; we see it at once on the diagram ; or if the steam is held too long in the cylinder and the pencil remains up when it should be down, we see it. If the back pressure is heavy during the return stroke, if cushioning is excessive or none at all, if the steam pressure drops excessively during admission, or if the general behavior of the steam while at work is faulty, you can read it on the diagram. Besides, most important results can be obtained from it by calculation and measurement. In all cases, the length of the diagram, whatever it may be, is the stroke of the engine from which it was taken, and the heights or amounts of pressure on the diagram are measured by the scale of the spring that was in the instrument when the diagram was taken. Generally the first thing to be done is to determine the M.E.P. Till within a few years ago the only method in general use was by ordinates. In this case, any line drawn perpendicular to the atmospheric line is an ordinate, same as these perpendicular lines on the blackboard. To do this in the usual way take a short, straight edge and lay it on the diagram, so that one edge coincides with the atmospheric line ; then with a small set square erect two lines touching the diagram at its ends. This defines the length of the diagram, and this length is to be subdivided into any number of equal parts, but not less than 10. This can be done by trial with a small pair of spring bows or dividers, but much better with a scale of 30, 40 or 50 to the inch. Apply the scale to the diagram and slant it till a convenient number can be read between the perpendiculars already erected, then with a needle point, or a fine point of a hard pencil make marks on the paper corresponding to the divisions on the scale ; then with your straight-edge and set square draw ordinates through your divisional points. But an incomparably better method is to use this instrument which is made specially for this purpose. Lay it on the diagram and open or close it till the length of the diagram is bounded by the corresponding edges of the two outside bars. Hold it there, and with a sharp pencil rule off each bar ; then you have it most accurately divided into 10 equal parts. Looking at our diagram after this is done we see that each division has two properties in common—they are all of the same width, and the sides of each are bounded by straight lines. This makes it possible to measure the height of each with close accuracy ; then with the scale of the spring, measure the mean height of each division between the lines of the diagram. Pay no attention for the present to the atmospheric line. Add these all together and divide by the number of divisions—the quotient is the M.E.P. of the diagram. A better way is to lay off the division heights on the edge of a strip of paper, one after the other in succession, no breaks ; measure the length of the whole with your foot rule, multiply that amount in inches and decimal parts by the scale of the spring, and divide by the number of divisions. This method is more expeditious and accurate than the first one.

(To be Continued.)

PERSONAL.

Mr. J. C. Palmer, a promising young electrician, son of the proprietor of the Palmer House hotel, Toronto, succumbed to a severe attack of diptheria in this city, a fortnight ago. He had recently resigned a position with a New York electrical firm to take the management of the Kirby House at Brantford, of which his father is also proprietor. Deceased was a member of the National Electric Light Association of the United States and his application for membership in the Canadian Electrical Association was to have been presented at the next meeting of the Executive Committee. Of a genial disposition, the deceased was held in much regard by a wide circle of acquaintances, by whom his untimely death is deeply deplored.

PUBLICATIONS.

The April *Arena* is rich in able, thoughtful papers. Its table of contents is as varied as it is inviting. Although the most liberal and progressive of all the great reviews, the *Arena* is prospering in a manner which indicates the trend of public thought and proves that the people admire brave, outspoken, and earnest magazines.

Germany now employs for its electrical machines 731-stationary steam engines, which represent a total of 38,544 steam horse power and 63 locomotives, developing 1,266-horse power, says *Electricity*. This 39,610-horse can furnish 400,000 incandescent lamps of 16-candle power each. One hundred and seventy-seven stationary steam engines and 12 locomotives of 10,000-horse power are used in other electrical industries.

THE ELECTRIC TRANSMISSION OF POWER.*

By Gisbert Kapp.

Lecture III.

(Continued from April Number.)

I have occupied some time in putting before you this transmission plant, because exact information about successful engineering work is of great value to practical men; and the Schaffhausen plant is certainly one of the best and most successful examples I could have chosen. The power transmitted is certainly large, according to our present ideas, but there is good reason to believe that—in point of magnitude at any rate—this transmission will very soon be eclipsed by other work of this kind. There are projects afloat for utilizing the power of the Rhine, near Bâle, to the tune of tens of thousands of horse-power, and at Niagara, as you all know, a total of 125,000 H. P., or a little over 3½ per cent. of the total power of Niagara, is to be taken from the Falls and transmitted to various distances, the longest distance being some 20 miles. I am not in position to give you details of any of the schemes which have been submitted to the Niagara Commission, since these are the property of the Cataract Company, but, by the courtesy of several members of the Commission, notably Dr. Coleman Sellers, I am able to give you a general outline of the schemes. My object in applying to the Niagara Commission for information of this kind was to obtain some indication of the opinions which leading modern engineers entertain of electric power transmission, and to put the result of my inquiry before you. Lest the general condition of the Niagara scheme may not be quite familiar to all of you, I shall now throw upon the screen a picture of the Falls, and give you very briefly an outline of the objects for which the Cataract Company has been established.

Of the immense power represented by the descent of the river from its upper to its lower level over the Falls (about 3½ million H.P.), there is utilized at present an aggregate of only about 5,000 H.P. in the mills you see on the left of the picture. The water is brought to these mills by a surface canal from the upper reaches of the river, and, after passing through turbines, is discharged into the open air about half-way between the level of the ground and the level of the river below the tail races, forming a number of miniature water falls. Only about half the available head is therefore utilized. If the system adopted hitherto could be followed in future, there would be little difficulty in establishing a station for the generation of any amount of power in this locality, but there is a strong tide of public opinion against the establishment of any more hydraulic works on the river bank, to say nothing of the difficulty of finding room for them and the open-air canal which would be required. The Cataract Company have, therefore, resolved to carry out their operations, to a great extent, underground; and at the present moment are driving a tunnel 30 ft. high by 20 ft. wide, and about 6,700 ft. long, which is to serve as a tail race for the water coming away from their power station. This tunnel is shown on the picture by two dotted lines, and its mouth is partly submerged under the level of the lower river. The total fall between the upper and lower river is 200 ft., and the net fall available for the turbines is 140ft. The fact that the tail race is a tunnel necessitates the turbines being placed at least 110ft. underground, since the suction tube of a turbine cannot be made longer than the column of water which can be balanced by atmospheric pressure, and this increases very materially the engineering difficulties of the work.

Last summer the Cataract Company invited a limited number of engineers to send in projects for the creation and transmission of power, and instituted a Commission, under the presidency of Sir William Thomson, to investigate and report on the projects. There were in all 20 competitors, but of these only 14 complied with the programme drawn up by the Commission, and were therefore held to be qualified to have their projects examined. Of these 14, eight competitors sent in combined projects for the creation and transmission of power, four referred only to the creation, and two to the transmission of the power. The point of interest to us is what methods were suggested by the 10 qualified competitors in transmission. The question is somewhat complicated by the fact that some competitors have suggested mixed systems of transmission, and that, in classifying the schemes into electrical, pneumatic, and hydraulic, we must count some competitors twice over. On this basis I find that the following represents the transmission projects:—Electrical, 7; pneumatic, 6; hydraulic, 2. It is certainly remarkable that the balance in favor of electric transmission should be so small. And it is equally remarkable that there should have been as many as six competitors who either wholly or partially advocated pneumatic transmission. The experience of colliery managers goes to show that even over the comparatively short distances over which they use pneumatic transmission, the total efficiency lies generally between 20 and 30 per cent., and does certainly not exceed 40 per cent. We cannot suppose that engineers who have sent in pneumatic projects are ignorant of this fact, or, at any rate, we must suppose that the majority of them are quite aware that high efficiency cannot be expected from compressed air transmission. If, nevertheless, they have adopted compressed air in preference to electricity, it must be for one of two reasons. Either they have no confidence in the capabilities of electric transmission, or they consider the cost so high that the interest on the extra capital and the greater depreciation of the plant will more than counterbalance the advantage of high efficiency. It cannot be denied that, in the present state of our knowledge of electric transmission, there is some ground for both these views. The Niagara problem is unique, both in magnitude and distance, and I am bound to confess that we electrical engineers are at the present moment not quite prepared to face it. At the same time I must say that I feel convinced that in a few years from now there will be not one, but a dozen men ready to face this problem with a very good chance of successfully solving it. As a matter of fact, we are at present on the threshold of a new system of electric power transmission. The old system of using continuous currents and ordinary dynamos has been perfected to a point which leaves little to be desired, but it has its limits, and, unfortunately, the Niagara problem, or at least a part of it, is just a little beyond these limits. Hence we find that only about half of the competitors have had the courage to propose electric transmission. Of these, only two suggested the use of alternating currents at voltages of 5,000 and 10,000 respectively; the others followed the old lines of continuous current transmission at voltages varying between 1,600 and 4,500 volts.

This brings me to the consideration of a subject which is of great importance not only in regard to the Niagara problem but to long distance transmission generally, namely, the limits of distance up to which the usual system of transmission is practicable. If you will refer to the table giving the cost of transmission plants, given in my last lecture, you will find that, for large powers at any rate, an increase of distance up to four or five miles does not make the cost prohibitive, and you will conclude from these figures that, within a five mile limit, the whole system of electric transmission is certainly feasible. How much farther you might go is a matter for theoretical consideration; the table does not help you much, as the only example of a very long distance transmission is one where the power is small, and is, therefore, in a certain sense, misleading. I have given you a formula by which you can calculate the most economical voltage for any distance; and if you do this for many cases, taking, for instance, 500 H.P. as your unit of power, you will find that as the distance increases beyond five miles, the economical voltage begins to grow beyond the limit which might be considered practicable for one machine. It is quite impossible to lay down hard and fast rules. Under certain conditions, especially if you have to transmit cheap water-power, you may possibly reach a distance of 10 miles before getting to the limit of voltage; but, whatever may be the special conditions of the problem, there is a limit of distance beyond which a single machine will not reach. "Very well, then," you might say, "if a single machine cannot be made to give the required pressure, let us put two or three machines in series." To correctly appreciate such a suggestion; let us first of all see what limits the voltage of a machine. Two things limit it; the commutator and the general insulation. Practical dynamo makers will tell you in large machines they are quite prepared to put 1,000 volts on the usual Pacinotti commutator—if necessary, they will go to 2,000 volts, but with some misgiving; and if you ask them to make a machine for 3,000 volts, they will, as likely as not, refuse. I do not refer to the Thomson-Houston or Brush machines, which have special commutators, but to large machines giving an even current and a high efficiency, such as we require in the transmission of power. We may thus conclude that 2,000, or, at the outside, 3,000 volts, is the limit of voltage to be obtained from a single commutator. But the general insulation of the machine must also stand this pressure, and where, as in dynamos and motors, the insulation consists of cotton, paper, fibre, varnish, and like materials, which are subjected not only to electrical, but also to mechanical strains, 3,000 volts is quite high enough for safe working. The commutator difficulty can, of course, be got over by putting several machines in series and insulating their frames from earth. The difficulty of general insulation can, however, not be met so easily. This you

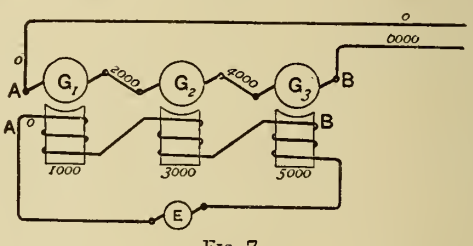


Fig. 7.

will see by referring to Fig. 7, which shows, diagrammetically, three 2,000 volt machines placed in series. Shunt excitation at the high pressure of 2,000 volts is, of course, out of the question; series excitation introduces complication and certain difficulties, especially at the motor station; and separate excitation, although simple and easily worked, has the disadvantage of throwing great electrical strains upon the insulation between the exciting coils and the frames of the machines. Imagine, for instance, that there is a weak place at A, between the exciting coil and the frame of the first machine, then the strains between the exciting coil and the frame of the third machine at B, will be about 6 000 volts, even if all the machines are perfectly insulated from earth. With series self-exciting machines, the strain would, of course, be limited to 2,000 volts, but there still remains the difficulty that all the armatures would have to be mechanically connected by insulated couplings, and there would also be great danger in touching even the iron frame of any machine. You see the use of several machines in series is not such an easy matter as it may look at the first glance, and this method has, as far as I know, only been adopted in cases where the total voltage was under 2,000.

The net result of our investigation may be stated by saying that the electric transmission of power by continuous currents is economical and safe up to distances for which the most economical voltage does not exceed 2,000 or, at the outside, 3,000 volts, but that beyond these distances some other system must be applied. That this other system must also be electrical is evident, for we know perfectly well that distances beyond the reach of our present electric transmission systems are hopelessly beyond the reach of lines

*Cantor Lectures delivered before the Society of Arts, February and March, 1881.

of shafting, flying ropes, air, or water. Now what is this new electrical system which shall enable us to carry power over ten or twenty, or perhaps a hundred miles?

In attempting to answer this question I must perforce leave the safe ground of solid facts and engineering practice, and enter into the domain of speculation. Yet speculation based upon experimental results which in themselves are as reliable as were those experimental results which have led to the practical development of electric power transmission as we know it now.

The starting point in the theory which I have now to bring before you is the well-known disc of Arago. If a copper disc be rapidly revolved under a compass needle, the latter is also set into rotation. I am able to show you this experiment, by the kindness of the Science and Art Department, who have lent me the apparatus you see before you. Between the copper disc and the compass needle is placed a sheet of glass so as to prevent air currents from affecting the needle. If I set the disc in motion you see that the magnet very soon follows. To make the motion of the latter better visible, colored pieces of paper are attached to the poles. Now, the fact that the magnet revolves is evidently due to there acting upon it some mechanical force. The explanation is perfectly simple. The disc, in passing under the poles of the magnet, becomes the seat of a very complex system of electromotive forces, which produce an equally complex system of curreuts. Some of these currents cross the path of the lines of force emanating from the magnet, and thus mechanical forces are set up beween the disc and the magnet, causing the latter to rotate. It is as though there existed between the disc

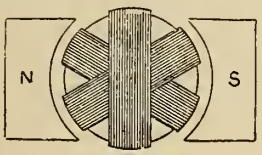


FIG. 8.

and the magnet a kind of electro-magnetic friction by which the magnet is dragged after the disc. Since all motion is relative, it is perfectly clear that we might regard the magnet as revolving, and then the disc will be dragged after it. With the apparatus before you this experiment would not succeed, since the magnet is small and the disc is heavy; but if we were to employ a very strong magnet, and revolve it rapidly enough, there would be no difficulty in setting the disc in rotation, and even obtaining power from it. I have said a moment ago that the system of currents set up in the disc is very complex, and you will easily see that only those currents which are more or less radial, and of those only their radial components, are instrustrumental in exerting mechanical force, whilst all the other currents represent simply so much waste power. To make an efficient machine we must, therefore, not employ a continous disc, but a system of conductors, so arranged as to force the currents to flow as much as possible in a radial sense, and only in those places which are immediately under the influence of the magnetic field. Or, better still, we may abandon the disc shape of conductors altogether, and substitute an armature with a laminated iron core of the drum type, seen end on in Fig. 8, and use, instead of a straight magnet, a horse-shoe magnet, so shaped as to bring its poles, N S, to opposite sides of the drum, and wind the latter with a number of coils closed in themselves. If we now revolve the magnet, strong currents will be generated in each coil successively, and a very small torque will be exerted on the armature. The torque will, in fact, be comparable to that required to revolve an ordinary continuous current drum armature in a strong field, if we short circuit the brushes. Here, you see, we have, by applying a few very obvious improvements to the Arago disc, at once obtained a machine of very considerable power. Imagine both the magnet and the armature mounted on independent spindles (not shown in the diagram, but passing both at

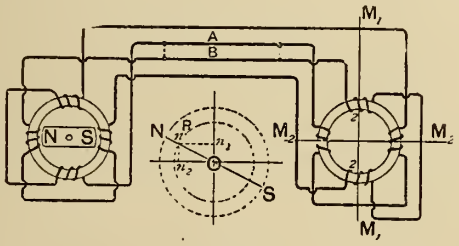


FIG. 9

right angles through the centre of the figure), then it is perfectly clear that power given to the magnet spindle is transmitted, by electro-magnetic induction, to the armature; and a large portion of it may, therefore, be obtained again from the armature spindle. Here we have, certainly, transmission of power, but not of the kind we require, since the distance of transmission is nothing. Now, what we want to do is to so alter our machine as to separate the two parts. We want the magnet in one place and the armature in another place, miles away. If, in this case, we succeed in transmitting rotation from the magnet to the armature, then we shall have solved the problem. This problem has been solved by an Italian electrician, Prof. Galileo Ferraris, of Turin, who, early in 1888, communicated to the Turin Academy the results of his investigation on rotating magnetic fields produced by alternating currents. To clearly see the bearing which Ferraris's investigation has on our problem, let us inquire what it is we want at the motor station. We want there an armature, as shown in Fig. 8, and a magnetic field, the lines of which shall pass through the armature, and shall revolve round its centre. Whether the field is due to a real magnet, or is produced by any other means, is immaterial; and it is the merit of Ferraris to have shown us how to produce such a revolving field without the use of a real magnet, but simply by the use of two distinct alternating currents passing through fixed coils.

As the subject is new, and will not be found in any of the numerous textbooks dealing with electrical engineering, you will, perhaps, not think it out of place if I put it before you in rather an elementary manner, beginning with the simplest possible case, and passing gradually to the more complicated cases. Assume, then, a combination of apparatus, as shown in Fig. 9. Here you have, on the left, an annular iron core wound with two coils, which are connected in series, and to a pair of line wires going to a similar

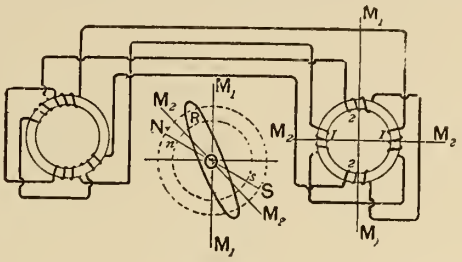


FIG. 10.

coil on the right, which may be at any distance. Into the circular space enclosed by the first coil we put a straight bar magnet, N S, which can revolve round the centre. As the poles sweep past the wire turns, an E.M.F. is induced, and a current is caused to flow, the direction of which changes twice in every revolution. We have here, in fact, an ordinary alternate current generator, with stationary armature and revolving field magnet. By suitably proportioning and placing the various parts of the apparatus, we can make the E.M.F. and the current curve of a true sine character; and in order to simplify the treatment, I shall assume that in this, and in the cases which follow, the design is such that all the E.M.F. and current waves follow the sine law. The alternating current, in passing through the coils on the right, magnetize the iron core, so as to develop north and south polarity in the line M1 M1. The effect is the same as if we placed into the ring a vertical magnet which is collapsible, the two poles shrinking into a point at the moment that the current strength is zero, and coming apart vertically as the current increases. We must imagine this magnet alternately shrinking into nothing and growing larger and stronger; also reversing its polarity each time that it passes through its zero condition. In the apparatus shown by Fig. 9, therefore, rotation of a real magnet on the left produces merely an orcillating magnetic field on the right. As you know, a magnetic field may be represented graphically, in direction and magnitude, by a straight line; and, in this particular case, the line so representing the oscillating field is the projection of the radius, O *n*, on the vertical M1 M1, if the length of the radius, O *n*, represents the strength of the field at maximum current. At the moment to which the diagram refers, our collapsible magnet will, therefore, have grown to the strength represented by the length, *s*1 *n*1; and,

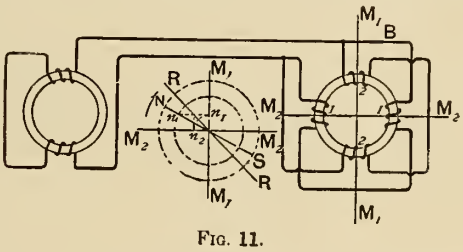


FIG. 11.

if there were no lag, the real revolving magnet would, at that moment, occupy the position, S N. As there must be some loss in the transmission, I have shown N at a larger radius than *n*. If there is lag then *n* and N will not lie on the same radius, but *n* will occupy, say, the position *n'*, and the strength of the oscilating field will be *n*1', *s*1'. The practical effect of lag is this, that the revolving magnet will have passed the vertical position shown in the diagram by the time the current has reached its maximum; and I can, therefore, eliminate the lag from the graphic diagram, by assuming that the revolving magnet has been shifted back through an angle equal to the angle of lag in this diagram, but left in its true position in the diagram representing the apparatus itself. In Fig. 9 the coils on the ring on the right hand are placed on the horizontal diameter. If, as in Fig. 10, I place them on the vertical diameter, the resulting oscillating field will be horizontal, namely, on the line. *m*2 *m*2; and the projection of *n* on the vertical must be taken over to the horizontal, as shown by the dotted quarter circle. Let us now suppose that we have both horizontal and vertical coils on the ring, as shown in this figure, then the combined effect of these coils will be to produce an oscillating field on the line, R R, the strength of the field being, as you will easily understand, about 40 per cent. greater than in either of the former cases; but still the field is not a revolving one. I can show you the production of an oscillating field, as here explained, by means of a mechanical model.

Up to the present, then, we have not advanced in the solution of our problem. We have produced at the distant point an oscillating field; but what we want there is a revolving field; and to get this we must duplicate the apparatus shown in Fig. 9, by putting horizontal coils on the generator and

vertical coils on the motor ring, in addition to the coils already there. This arrangement is shown in Fig. 11. Now, the field produced by the coils, 1 1, is given by the projection of O *n* on the vertical; and that produced by the coils 2 2 is given by the projection of O *n* on the horizontal. The resultant of these two fields is therefore O *n*, the point *n* revolving round O as a centre on the circle R. The effect of revolving a real magnet within the generator ring is, then, to produce a revolving magnetic field of the strength O *n* within the motor ring, a kind of revolving phantom magnet which, for our purpose, is quite as suitable as a real magnet. I can also show you this effect by means of the mechanical model.

You observe that in Diagram 11 four wires are shown, connecting the generating and receiving machines. Now, as the absolute potential of any of these wires may be chosen arbitrarily, there is obviously nothing against choosing it at such a value as will make it coincide with the absolute potential of another wire not belonging to the same circuit. We might thus, for instance, equalize the potential between the wires A and B by connecting them at either terminus, as shown by dotted lines, and not disturb in any way the satisfactory working of the machines. Or, better still, we may omit one of the wires altogether, and use the other as a common wire for both circuits, and thus reduce the total number of wires to three. The common wire must, however, have about 40 per cent. more carrying capacity, since the algebraical sum of the two currents is 1·4 times the strength of each current taken singly. Here you have, then, the theoretical solution of the problem of how to transmit power by alternating currents, as indicated by Ferraris, but the first to attack this problem practically was Mr. Tesla, an American electrician, and such motors are, therefore, also known under the name of Tesla motors, though the name "Ferraris motor" seems to me to be more appropriate, as distinguishing this motor from the two-wire Tesla motors, about which I shall say something presently. To carry out a power transmission by means of such a system, we must have at the generating station an alternator, the armature of which is wound with two circuits giving currents with a quarter period phase difference, three-line wires, and a motor having a laminated field magnet, which is excited by coils placed alternately in the two circuits so as to produce a revolving field. The armature of this motor must have an iron core, surrounded with coils closed in themselves.

The necessity of using three-line wire is, to a certain extent, a disadvantage of this system, and several engineers, Mr. Tesla foremost amongst them, have tried to improve the system in such a way that two-line wires only should suffice. The methods suggested have this in common, that all aim

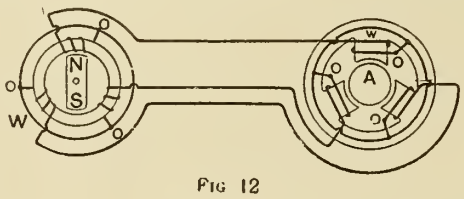


Fig 12

at producing a difference in phase between the currents passing through the motor, without the use of a second set of coils on the generator. If we insert, for instance, a large inductionless resistance into the branch B in Fig. 10, and a coil having very little resistance, but great self-induction, into the branch A, the current in the coils 1 1 will lag by a small amount behind the E.M.F. impulses of the generator, whilst the current in the coils 2 2 will lag behind the impulses by a larger amount. The phase difference between the two currents can, of course, not amount to 90 deg., which angle is required for producing the best effect, but some difference of phase can certainly be produced in this way. The arrangement will, in fact, be equivalent to that shown in Fig. 12, where the distance between the two sets of coils on the generator is less than 90 deg.

An easy geometrical construction, which I need not explain at length, shows that in this case the path of either pole of what I have before called the revolving phantom magnet is an ellipse, but that it can be made to be circular by a dis-symmetrical arrangement of the coils on the motor, though in this case the diameter of the circle is much reduced. In either case the value of the machine as a power-producing appliance is also much reduced, whilst at the same time the efficiency must be low, owing to the waste of power in the resistance coil. I can also show you the action of this two-wire motor by means of the mechanical model.

(To be Continued.)

TRADE NOTES.

The largest driving belt ever manufactured in Canada is that which is now almost finished and to be seen on a monster 60 inch hydraulic press (erected for the purpose) in the leather belting manufactory of Messrs. Robin & Sadler, 2520 Notre Dame street. This belt, when finished, will be placed in position on the driving pulleys of the Royal Electric Light Company's new engine at the establishment on Wellington street and will transmit 800 horse-power. It is made without a rivet and is a solid mass of leather, three-ply, cemented together by a pressure of thirty tons weight from the press. Its width is fifty-three inches; length 130 feet and about an inch in thickness, and of 2,000 lbs. weight. The outsides of the belt are without a patch, while the whole contains one hundred steer hides selected as to superiority from a collection of over 2,000. From the press the belt will be submitted to a special process known only to this firm whereby the surface will be made proof against oil absorption, when it will be ready for use. This firm is also manufacturing a belt forty inches wide, three-ply, for the Royal Electric Co.'s new 600 horse power engine.—*Montreal Daily Witness.*

SPARKS.

The City Clerk of Quebec invites tenders until the 4th inst., for supplying plant and lighting the streets.

The Bell Telephone Co. of Canada has been empowered by Act of Parliament to increase its capital stock from $500,000 to $5,000,000.

It has been found that half-burned arc carbons will cut glass. The street Arab has, unfortunately, discovered this fact, and now amuses himself by scratching plate-glass windows.

The Edison company has the contract for supplying an electric light and power plant at the Thousand Island Park. There are to be two dynamos with a capacity of 750 incandescent and 22 arc lights.

An electric plant for the purpose of drilling and lighting has been put in at the New Rockland Slate Co.'s works at Richmond Que. Two electric drills are now in successful operation, and a third will shortly be added.

A. Shaw's electric light works at Victoria, B.C., have been converted into a joint stock company with a capital of $75,000. Twenty-five per cent. will be retained by Mr. Shaw and the rest is taken up in New York, Vancouver, and Victoria.

The promoters of the Hamilton, Grimsby and Beamsville electric railway have arrived at a satisfactory understanding with the Hamilton civic authorities concerning right of way, and have in consequence definitely decided to build the road.

The Hamilton, Ont., street railway will be equipped with electricity. The contract, consisting of thirty cars and three multipolar generators with a capacity of 750 h.p., has been awarded to Ahearn & Soper, of Ottawa, Canadian representatives of the "Westinghouse system."

Messrs. Goldie & McCulloch, of Galt, have received the order for three 250 horse-power engines for the power house of the Hamilton electric street railway. It is the intention of the company to fit motors to fifteen of the present closed cars. Ten new large cars will be constructed.

The Westminster and Vancouver Tramway, connecting New Westminster with Vancouver, B. C., consists of 14 miles of track, vestibule cars, 30 feet long The round trip ticket is 75 cents; single fare, 50 cents; city fare, 5 cents. The traffic has averaged 400 passengers daily for eight round trips a day.

The Council of Toronto Junction is putting through a by-law granting cheap water and tax exemption to the City and Suburban Electric Street Railway Co. It is understood the company are acquiring the Davenport street railway franchise, and if the privileges asked for are granted they pledge themselves to commence the construction of both roads immediately.

An interesting and amusing instance of the efficacy of the London-Paris telephone occurred the other day which is worth recording. The Salvation Army band were marching from the Royal Exchange, London, playing the "Marseillaise" when an idea struck the members present in the telephone room. The windows and doors were thrown open and the attendant at the Paris end was asked if he could hear anything. The response (in French) was immediate. "Yes I can hear a band playing the 'Marseillaise.'"

On March 3rd the Bell Telephone Company paid to the city of Toronto $1,636, being five per cent. on its quarterly earnings, which goes to the city in payment of its franchise privilege. Last month the company made a contract with the city of Hamilton by which it binds itself to pay to the city $1,500 a year in quarterly payments, for the privilege of doing business there. The contract also specifies the rates to be charged for telephones, and is for the period of ten years, the tax to be readjusted at the end of that time.

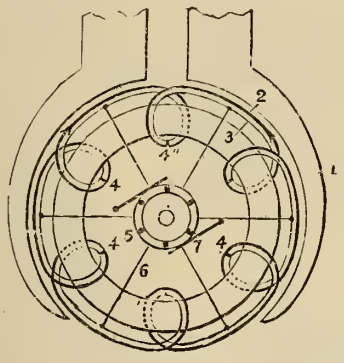
Faraday discovered that whenever a conductor was moved between the poles of a magnet a current of electricity was produced, and that it flowed in a reverse direction when revolved near the face of one pole to what it did when revolved near or across the face of the other pole. This principle underlies every description of dynamo or electro motor. The dynamo does *not*, as so many appear to think, produce its electric energy by friction. The energy is due entirely to the inductive action of the magnetic poles on the wire coils of the armature. The dynamo is a mechanical electric generator as a battery is a chemical electric generator, *i. e.*: in the first case the mechanical force expended on the dynamo to drive it will be converted into electric energy for lighting and running the lamps, or in driving the motor, and in the second case the chemical action or energy of the battery is likewise converted into electric energy for lighting and running the lamps or driving the motors, etc.

Prof. Elihu Thomson, the man whose brain has worked most of the mechanical ideas that have made the Thomson-Houston Co. rich and famous, is only about 5 feet four inches high, or, perhaps, a little taller. His figure is boyishly slight, and his face is very young in appearance. As it is, he is a few years short of forty. He was always famed for his precocity, and he had to wait two years before he could enter the high school in Philadelphia, because he was so young. He was a professor of chemistry before he was 23 years old. When he was 11 years old he began experimenting with Leyden jars, and continued experiments in electricity uninterruptedly until he was 13 years of age. He lived in Philadelphia, and when he'd try his 'prentice hand on his first dynamos he used to travel into the woods away from home to strip the elderberry bushes and get elder pith to make insulating material. He ought to be worth, says a contemporary, hundreds of thousands of dollars to-day, but he is comparatively poor, and he devotes his energies to the supervision of the technical electrical works of the company exclusively. Professor Houston, the man whose name is joined with his in the title of the company, is not directly connected with the concern, but is a professor of physics in Philadelphia.

EDISON'S WAY OF REDUCING SPARKING AT THE COMMUTATOR.

THIS improvement, says *Electricity* of New York, is described in the present instance as being applied to the armature in the form of a Gramme ring. Instead of winding a single wire on the armature core, as usual, Mr. Edison winds two or more conductors at the same time. Of the two wires thus wound, one it preferably a coarse copper wire and the other is a fine wire of a metal having a higher specific resistance, such as German silver. The latter conductor is employed particularly as a resistance wire, while the former is the wire which carries the larger part of the current generated in the machine.

The drawing will give a clearer idea of the method: 1, 1, are the two poles of a field magnet, 2, is the insulated copper wire of



the armature, and, 3, is the insulated German silver resistance wire. At the centre of each section of the coil of the armature ring the copper and German silver wires are electrically connected, as indicated at 4. The armature coils are connected to the segments of the commutator, 5, by German silver or other wires, 6, leading from a point approximately midway between two of the connections, 4.

Assuming that the armature is used in a dynamo, the operation may be explained as follows ;—As the armature is rotated, current is generated in opposite directions in the two sides of the armature, and these currents meet approximately over or above the commutator, the direction of the current being indicated by arrows. When the current on one side reaches the section between the points, 4' and 4", it will pass across the connection as 4', to the German silver wire, 3, and thence to a commutator segment and commutator brush, and the current on the opposite side of the armature will pass across at 4" to the German silver wire, and thence to the commutator, thus putting a section of the resistance wire in circuit and reducing the sparking at the commutator when the brushes pass from one segment to another.

It is not essential that the two wires be wound together for the whole length or that they should be wound together at all, and conductors of other materials than those mentioned may be employed. It will be evident that current will also be generated in the resistance wire, which current will be in the same direction as that in the copper conductor.

In an an article on trade journal advertising, *Printer's Ink*, which is published by Geo. P. Rowell & Co., advertising agents, who naturally have more business with newspapers of general circulation than with trade papers, says: "An inspection of the rate-cards of the best trade papers shows that they uniformly charge rather high rates, and an inspection of their columns shows that they secure a much larger proportion of advertising, than the mediums of general circulation. The conclusion is irresistible that advertisers find them to be worth what they charge."

VICTORIA B. C.

(Correspondence of the CANADIAN ELECTRICAL NEWS.)

The C. P. R. are now stringing their fourth wire between Montreal and Vancouver, three of these will be used for commercial purposes, and the fourth for company's business. They have just added Edison's phonoplex system to their line between this city and Victoria which is for the greater part under water.

A series of lectures on "Electricity" has just been given in the Whetham College. The first was delivered by Mr. J. G. Wilton, the second by Mr. J. Balfour Kerr, who handled "The Telephone" in an admirable manner. The third is to be by Mr Gaudil, who is to have the "Graphophone, Photophone and the Phonograph" as his subject. No admission fee is charged, which may or may not be the cause of the crowd who attend so far every lecture night.

A second Edison incandescent dynamo has been added to the sugar refinery plant, it is for the day circuit.

At Nelson, B. C., a small village a 1,000 light plant is being set up.

The Edison General Electric Co. have decided to build a much larger and more handsome block than the present block which they built las year, it being now found to be too small for the perfect handling of their business which has developed enormously.

Messrs. Marshall & McRae, lithographers, have put in an Edison motor, this makes the sixth machine in operation.

A new accommodation car has been tested on the tramway line and proved satisfactory. The car is constructed on the plan and about the size of the regular interurban carriages, about one-third of the space being partitioned off in front for baggage and express parcels, with a through passage from the messenger department of the car and with sliding side doors. The car will be run in connection with the Great Northern Express Company's service over the G. N. R.

After an interesting and very lucid paper by J. Fletcher, chief operator of the Canadian Pacific Telegraph, on "Telegraphy," in Whetham College, interesting experiments were tried over the wires, connected at the college with Portland, San Francisco, and Winnipeg. These cities were asked for weather reports, and a number of news questions were asked and answers recived on the typewriter, and read to the audience. From San Francisco in one minute and 30 seconds; Portland, one minute and five seconds; Winnipeg, two minutes. Frank Dowling, operator on the C. P. R., took 253 unabbreviated words sent by Mr. Fletcher from the main office, on a typewriter, without a mistake, in five minutes.

WESTERN NOTES.

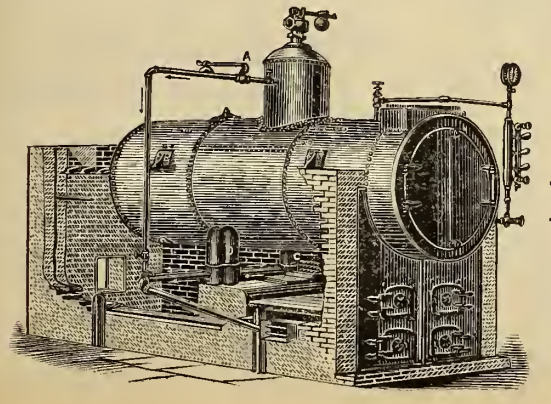
(Correspondence of the CANADIAN ELECTRICAL NEWS.)

Being an interested reader of your columns, and wishing the NEWS every success, I take it upon myself to send you some items respecting this part of the province.

The Port Arthur electric railway has been accepted by the town, and is proving to be a paying speculation from the start. The Council are now laying ties to continue the road into Fort William and have two years to complete the road to Fort William west. Farther west at Rat Portage, an electric fever seems to have struck the town. An electric light and telephone company have had a monopoly of the business for from three to four years, and have been charging high rates for light service, until the citizens rose in their might and have had incorporated another company known as The Citizens' Telephone and Electric Co. The charter is expected daily I understand, and upon its arrival work will be commenced upon the new works. They have a grand water power which will developed, furnishing power for the works, and they have already contracts for in the neighborhood of 1,200 lights. Another company is seeking a charter for the Rat Portage and Keewatin Electric Street Railway Company, and as soon as the incorporation is completed will, it is expected, proceed with the construction of a road uniting the three places, Keewatin, Norman and Rat Portage, making a road probably five miles in length.

The Winnipeg horse-cars will during the coming summer give way largely to the new electric street railway company, and arrangements are now being made for commencement of work upon the road.

The Peterborough Light and Power Co. is said to have contracted with the town for seventy-five all-night arc lamps at 25 cents per night, omitting moonlight nights.



President, W. F. HALL, Napanee Paper Co. LONDON, ENG. PHILADELPHIA, U.S.

THERMOLYTIC FUEL COMPANY

NAPANEE, - CANADA.

MANUFACTURERS OF

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FOR STEAM BOILERS AND FURNACES,

giving more economical results than are obtained by natural draught or any other system of using fuels.

Increased steaming capacity of boilers; Economy in combustion of coal; Easy work for fireman; Simple in design; Easily applied to any boiler; Durable; Inexpensive.

CORRESPONDENCE SOLICITED, SEND FOR CIRCULARS,

SPARKS.

The Edison Company are introducing incandescent electric light at Kincardine, Ont.

The town of Huntsville, Ont., has given an order to J. A. Farlinger & Co., of Toronto, to install a lighting plant. Four hundred lamps will be required.

Prof. Alexander Graham Bell has returned to Washington from his recent European trip and will soon leave for Boston, where he will engage in experimental work.

The necessary plant has been forwarded from Victoria for a telephone line between Port Simpson and Georgetown on the Pacific coast. This will he the most northerly telephone line on this continent.

If the volt and ammeters show that more current is being delivered than can be accounted for by the devices in use—then look for leaks and remove them, for so soon as formed they are a source of danger.

Acid spray from a battery of accumulators is said to be a great deteriorating agent where metal fittings and brass or copper conductors are about. A London firm set to work and invented an anti-sulphuric acid enamel, which is now largely used in many electrical works. For coating woodwork, iron and copper in the neighborhood of batteries it seems to have proved itself thoroughly successful, and the long list of names of electrical firms using this enamel shows its popularity and usefulness. Even with strong sulphuric acid it will resist for weeks. It is also a perfect protection against acid spray. It is applied exactly like varnish, in black or other colors.

SPLENDID OPPORTUNITY.

ELECTRIC PLANT FOR SALE.

The undersigned has for sale an ELECTRIC PLANT (incandescent), now in use in the rising town of Farnham, P. Q., with the franchise from the town. Also, lease of water power.

The plant is all new, in excellent order, and producing a good revenue.

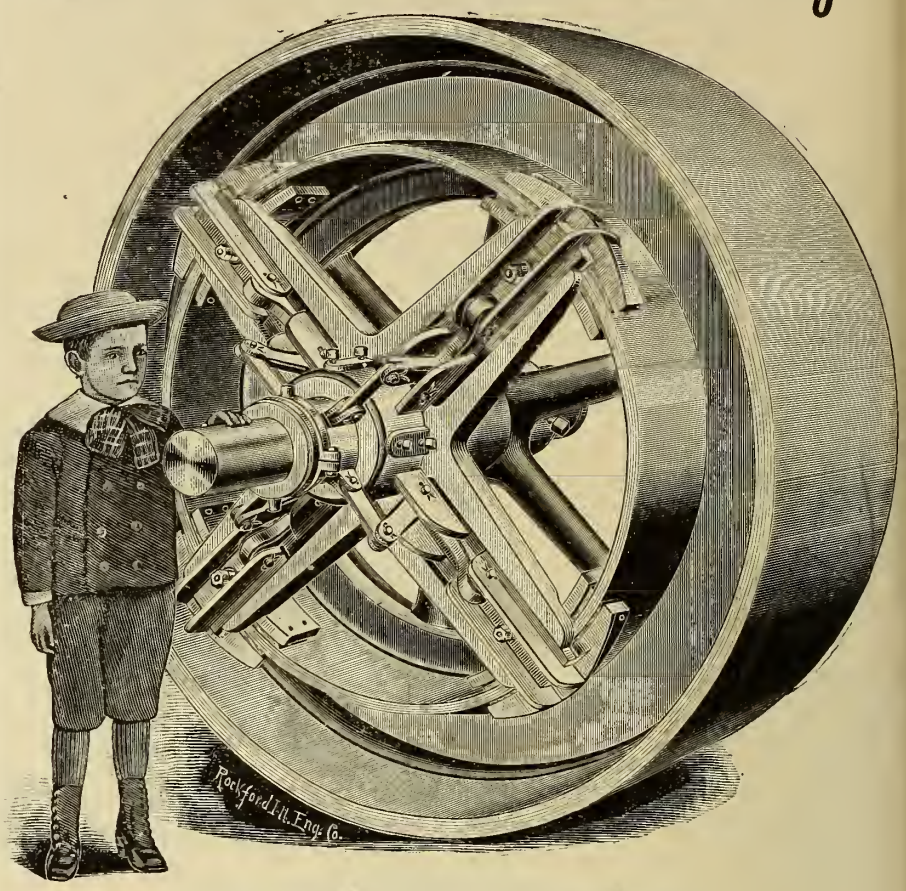
The system can be extended at small cost, and the demand for lighting is rapidly increasing.

Full particulars can be had from the undersigned.

A. W. STEVENSON.

Hamilton Chambers, 17 St. John Street, Montreal, 14th April, 1892.

Hill Patent Friction Pulleys



AND CUT OFF COUPLINGS

For Electric Light Stations and all purposes where intermittent power is required.

MILLER BROS. & TOMS,

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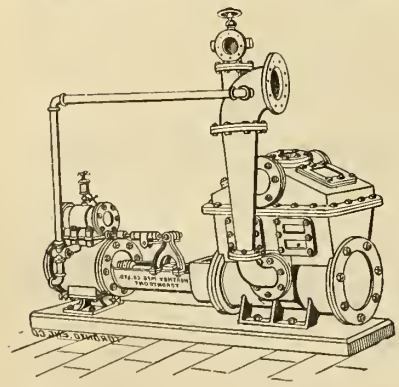
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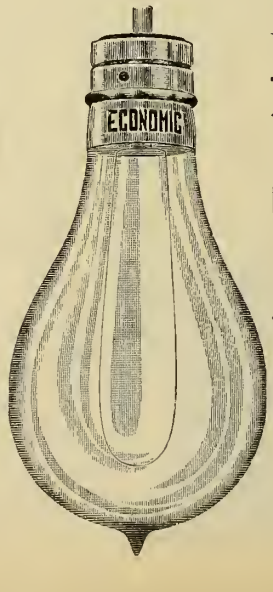
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BOSTON

251 ST. JAMES STREET, MONTREAL.

SPARKS.

The offer of the Edison Company for supplying an electric plant to the village of Lachine has been accepted.

It is said that the largest telephone switch-board in the world is that in the exchange in Berlin, with 7,000 wires.

Tracklaying on the new Hamilton electric railway has commenced. A couple of hundred men are engaged on the work.

Mr. J. J. Wright, manager of the Toronto Electric Light Co., accompanied the Toronto civic deputation in the capacity of electrical expert, to the United States in search of electric street railway information.

The amount of electric current that a very small wire will carry without heating to a dangerous extent, is many times greater, in proportion, than could be carried under the same conditions by a wire of larger size.

Mr. K. J. Dunstan, local manager of the Bell Telephone Co., Toronto, in company with the Co.'s electrician, will make a tour of a number of American cities, with the object of picking up the latest improvements in the line of telephone work.

Mr. F. N. Gisborne, chief of the Dominion Government Telegraphs, is advocating the advisability of the Government taking over the telegraphs. Mr. Gisborne favors using the more modern forms of multiplex apparatus which would materially reduce the number of wires required.

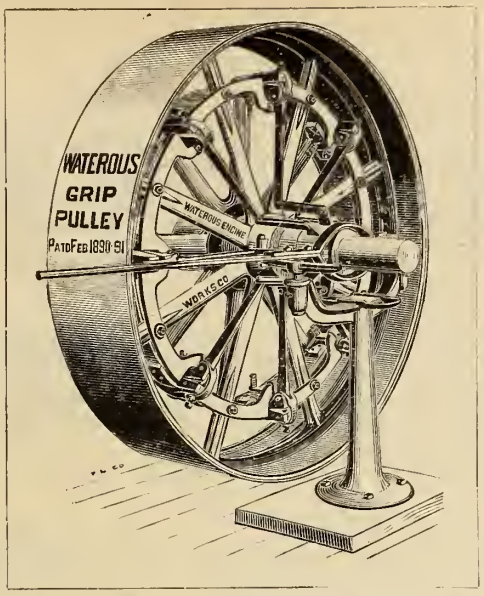
A lineman named Williams, employed by the Hamilton Electric Light and Power Company, fell from the top of a pole a few days ago and was severely hurt. The daily papers of course attributed his fall to contact with a live wire, but the manager states that such was not the case, as Williams was too experienced to touch a live wire.

According to the report read at the annual meeting of the American Bell Telephone Co., there are 512,407 telephones in use in the United States, requiring 266,456 miles of wire, which on the average allows a trifle over half a mile of wire to each instrument. This length of wire would circle the earth ten and a half times if stretched out in a continuous length, and dividing it by the number of years the telephone has been in operation (sixteen) would give 16,656 as the average number of miles of wire stretched each year.

A new arc lamp has recently been perfected by the Thomson-Houston Electric Company for indoor lighting on either arc or incandescent circuits. It is but 27¼ inches from top to bottom, six inches wide, and weighs 21 pounds without the globe. The feeding and regulation are said to be perfect, the arc being always the same length, perfectly steady, brilliant and free from hissing. The entire mechanism is carefully protected from dust and dirt. On arc circuits the lamps are run in series, and regulate and cut-off automatically. On incandescent circuits they are run in multiple or two in series, a small rheostat or bank of incandescent lamps being used as a controlling device.

It is a well known fact that in every dynamo the magnetic force necessary to develop the field in which the armature revolves is always greater than that which is usefully employed, that is to say, more lines of force are generated than actually pass through the core of the armature, the discrepancy being attributable to leakage at different points. To find out the amount and location of the leakage, ascertain exactly the ratio of lines of force actually generated to the lines passing through the core of the armature. This ratio will always be greater than unity. Some of the lines pass directly from one limb to the other, and some leak out of the yoke to the pole pieces. By placing a galvanometer in circuit and observing the deflections, the number of lines of force cutting or cut by a coil of wire in two or more given fields can be compared. The galvanometer must be a delicate one, as the resulting E. M. F. is usually comparatively low.—*Electrical Age.*

THE GRIP



PULLEY

The following is a copy of a letter received from Chicago, Ill. It shows the estimation in which the Waterous Grip Pulley is held by prominent electricians:

HAMILTON, CANADA, March 23rd, 1892.

MESSRS. THORNBURGH & GLESSNER, Chicago, Ill.

Gentlemen : At the request of Mr. C. H. Waterous, of the Waterous Engine Works Co., I take much pleasure in stating some of my experiences with clutch pulleys generally, and with the Waterous clutch pulley in particular.

Some five years ago, while Superintendent of Lighting for the Royal Electric Co., of Montreal, we had occasion to put in some new plants, including engines, shafting and pulleys, and concluded to adopt a clutch pulley in running our large dynamos. We put in four of them, two 34 in. and two 56 in. If one pulley went wrong—which the best of them will do occasionally—it necessitated the shutting down of the engine and shafting, to remedy the trouble ; well, a time came some two years ago when it was necessary for us to again increase our power plant, and in considering the clutch pulley question once more, the writer set about investigating the workings of the various clutch pulleys offered, and after going into things in as thorough a manner as possible, we closed with the Waterous people for three 22 in. by 93 in. pulleys, each one to drive 200 h. p. We did this because we found their pulley was the only one that would allow us to stop a pulley and stop the clutch both at the same time, so that it was only a moment's work to readjust a slipping clutch and throw the pulley on again ; then we found the item of less weight of considerable importance in them over others. They have been running for over a year and have given every satisfaction. Some six months ago the writer came to this city to take charge, and found it necessary to equip a new power house, and such was our confidence in the Waterous Clutch Pulley, and such our belief in its superiority over all others, that we have placed an order with them for twelve 38 x 14 in. and one 105x22 in. pulleys, and we feel satisfied that we are getting the best thing of the kind in existence to-day, combining as it does strength, lightness, and the ability to stop the clutch for setting up, without interfering with any of the other pulleys that may be running on the same shafting, an item which in our opinion makes them worth at least 100% more than those that do not stop.

Yours very truly. D. THOMSON, Gen.-Manager.

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Rubber Beltings, all kinds of Hose, Packings, etc.
Mould Goods of every description.

WESTERN BRANCH:

COR. FRONT AND YONGE STS.,

J. H. WALKER, Manager. - TORONTO.

The electric street railway between Windsor and Walkerville is now in full working order, and is claimed to be one of the best equipped and complete roads on the continent. It runs in connection with the Sandwich branch at Windsor.

A local paper tells of a novel bet that was wagered and won in Kincardine recently. It was not an election bet, but an electric bet. Sam McLure, who runs the electric light dynamo in that town, made a bet with Ben Hadley, a blacksmith, that the latter could not lift a door latch with a poker. Hadley thought he had a snap, no doubt, as he readily accepted. McLure had previously run a concealed wire from the battery to the latch, and lay in weight for the blacksmith. Hadley went to work, McLure turned on the current. The result need not be described.

THERE IS BUT ONE PORTLAND

Oregon, and it is best reached via Chicago and St. Paul over the through Sleeping Car Line of the Chicago, Milwaukee & St. Paul and Northern Pacific Railways. For further information apply to the nearest ticket agent or address, A. J. Taylor, Canadian Pass. Agent, 4 Palmer House Block, Toronto, Ont.

FIRSTBROOK BROS.

King St. East, - TORONTO.

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LEATHER BELTING

70 KING STREET EAST, TORONTO.

HEADQUARTERS FOR

ELECTRIC LIGHT AND DYNAMO BELTING.

We have the following Leather Belts in use in the works of the Toronto Electric Light Co. :—

One 36 inch belt 98 feet long.
One 36 inch belt 100 feet long.
One 36 inch belt 123 feet long.
One 38 inch belt 100 feet long.
One 24 inch belt 100 feet long.
And over 1500 feet of 8 inch belting.

All of the above belts are DOUBLE THICKNESS. The 38 inch belt is the largest belt ever made in this Province.

We are prepared to furnish belts of any size, two or three ply up to 48 inches wide. Every belt fully guaranteed.

SEND FOR DISCOUNTS.

Dixon's Belting Hand-Book mailed free on application.

TRADE AMERICAN IMPROVED ANTI-FRICTION METAL MARK

AMERICAN IMPROVED

ANTI-FRICTION METAL

The best metal for journal bearings of any kind, but

Especially Adapted to High Speed Engines

This metal is warranted not to heat or cut the journals, and its lasting qualities make it superior to any other metal.

IT IS *self-lubricating.*
tougher and more durable than all other metals.
the best metal known where great pressure is required.

It runs with less friction than any other metal.

It will stand the highest rate of speed and will not heat or cut.

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ANY DESIGN OR SIZE

FOR ELECTRICAL PURPOSES

Our Pulley is now in use in MOST PROMINENT STATIONS throughout United States and Canada.

SEND FOR ESTIMATES.

☞ **DODGE WOOD SPLIT PULLEY CO.,**

Office, 83 King Street West, TORONTO, ONT.

SPARKS.

The Brooks Mfg. Co., of Peterborough, who were recently burned out, are again in good working order.

Mr. S. Worth, of London, Ont., has been elected a member of the Executive of the Order of Railroad Telegraphers.

The Canada Electric Light Company gives notice that it will apply to the Legislature at its present session for an act to amend its charter.

The Montreal Telegraph Company has paid a two per cent. dividend, amounting to $40,000. This is the eleventh dividend declared by the company.

The blowing out of the man heads of the boiler in the Vancouver electric light station recently, was the means of temporarily extinguishing the lights throughout the city.

The Times Printing Company of Hamilton will shortly operate their presses by electric power. The current will be supplied by the Hamilton Electric Light & Power Co.

THERE IS BUT ONE PORTLAND

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ANTI-FRICTION METAL

The best metal for journal bearings of any kind, but

Especially adapted to High Speed Engines

This metal is warranted not to heat or cut the journals, and its lasting qualities make it superior to any other metal.

IT IS *self-lubricating.*
tougher and more durable than all other metals.
the best metal known where great pressure is required.

It runs with less friction than any other metal.

It will stand the highest rate of speed and will not heat or cut.

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THE

THOMSON-HOUSTON

INTERNATIONAL ELECTRIC CO.,

BOSTON, MASS.

Hereby announce that it is now manufacturing and prepared to manufacture and sell under the various Letters Patent of Inventions now held or owned by the Company and through its Agents in Canada,

The Toronto Construction & Electrical Supply Co.

Offers for sale and solicits orders for the following apparatus:

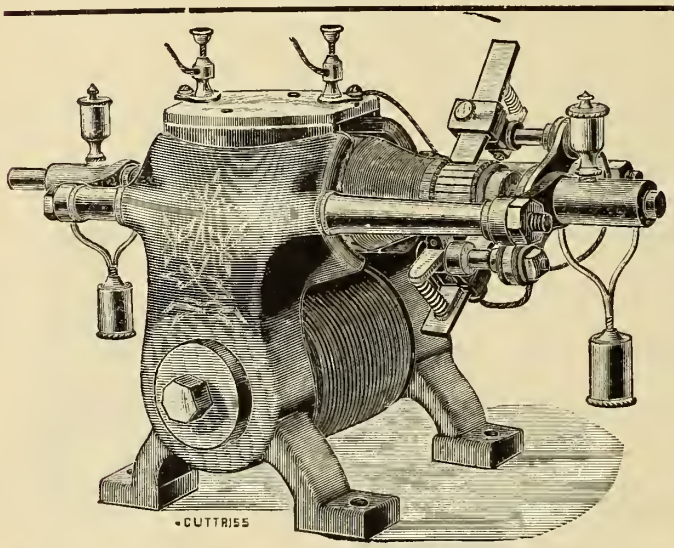
Alternaitng Incandescent Dynamos,
Continuous Current Dynamos,
Generators for transmission of power.
Motors, Railway Motors and Equipments,
Electric Reciprocating Drills,
Arc Lighting Machines.

The above may be obtained at reasonable prices by any person requiring them, from

THE TORONTO CONSTRUCTION & ELECTRICAL SUPPLY COMPANY,

WHOSE HEADQUARTERS ARE AT

No. 63 to 69 FRONT STREET WEST, TORONTO.



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NO. 263 JAMES ST. N. - HAMILTON, ONT.

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For Arc and Incandescent Lighting.

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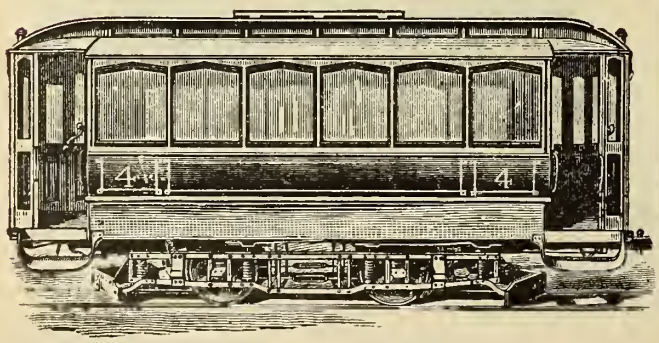
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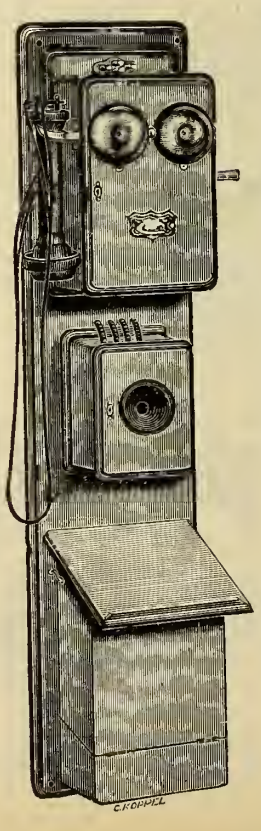
.... OUR SPECIALTY ....



We also manufacture Horse and Trail Cars of every description.

PATTERSON & CORBIN,

ST. CATHARINES, ONT.



NOTICE OF REMOVAL.

WE beg to announce that we are removing this month to new premises,

749 CRAIG STREET,

where with larger accommodation and greatly increased facilities, we will be in a better position than ever to turn out our standard Main Line and Warehouse Telephones. Send for catalogue of Electrical Supplies of all kinds. Note a couple of sample testimonials:

WATFORD, ONT., Feb. 9, 1892.
T. W. NESS, Montreal, Que.

DEAR SIR,—We wish to secure four (4) of your telephones as soon as you can ship them to us. The ones we got from you last gave good satisfaction.

Yours truly, DS. McLEAY & AULD.

MILVETON, ONT., Nov. 9, 1891.
T. W. NESS, ESQ., Montreal.

DEAR SIR,—The whole line is working first-class. Any one wishing to know about your telephones, you can refer them to me. I think any person with ordinary intelligence could set them up.

Yours truly,
J. F. CATTERMOLE, M.D.

MONTREAL, April 7, 1892.
T. W. NESS, ESQ., City.

DEAR SIR,—Replying to your favor of the 5th inst., we beg to say that the telephone instruments which you put into our mill last year to connect our different departments are working very satisfactorily, and we find them a great convenience. We would certainly recommend anyone desiring a system of telephones for their works to adopt those made by you.

Yours truly,
DOMINION WIRE MFG. CO.

T. W. NESS

749 Craig Street, - Montreal.

CANADIAN

ELECTRICAL NEWS

AND

STEAM ENGINEERING JOURNAL.

VOL. II. TORONTO AND MONTREAL, CANADA, JUNE, 1892. No. 6.

THE OTTAWA BLIZZARD.

WE present on this page an illustration of a scene whose like has probably never been witnessed outside of Canada, viz., the destruction of electric property on the Streets of Ottawa, by a blizzard on the 11th of March last. The electric wires became so laden with snow that for a distance of two miles in Rideau street, every pole broke beneath the burden.



THE WORK OF A BLIZZARD AT OTTAWA, ONT.

The Bell Telephone Company estimate their loss at $20,000 ; the telegraph companies were also heavy losers.

If such occurrences were likely to be frequent, the telephone company at least would require but little persuasion to induce it to place its wires underground.

At a meeting of the provisional directors of the Nelson, (B. C.) Electric Light Company, Limited, it was decided to offer 2,500 shares of the capital stock of the company for subscription. The contract for building the dam, flume and power house will be immediately awarded. The directors elected John Houston, President ; J. A. Gilker, vice-president ; J. Fred Hume, treasurer ; and W. A. Crane, secretary.

Messrs. H. W. Darling, of Toronto ; Marshall D. Barr, manager of the Edison General Electric Company, Toronto ; John Langton, of Peterboro ; Samuel Insull, second vice-president of the Edison General Electric Company, New York, and Henry M. Francis, of Peterboro', are seeking incorporation as the Canadian General Electric Company, Limited, with headquarters at Montreal, and a capital stock of $1,000,000.

CANADIAN ELECTRICAL ASSOCIATION.

A MEETING of the Executive Committee was held in the offices of the Hamilton Electric Light and Power Co. on May 10th.

There were present Messrs. J. J. Wright, President, in the Chair ; K. J. Dunstan, A. B. Smith, E. S. Edmonson, D. Thomson, T. H. Wadland, John Yule and the Secretary By invitation, Mr. George Black, of the G. N. W. Telegraph Co., was also present during a portion of the proceedings.

It was thought best in view of the fact that the management of the Industrial Exhibition are desirous of affording facilities for an electrical exhibit in Toronto next year, that no further action be taken towards holding an exhibition the present year, and was so decided.

The Secretary was instructed to correspond with the Secretary of the Hamilton Board of Trade to ascertain whether the Board would grant the Association the use of its rooms for the meetings in connection with the approaching Convention.

It was resolved that the Secretary should send a circular letter to the members of the Association, advising them of the date of the Convention, and instructing them when purchasing railway tickets for the Convention, to buy single ticket one way, and ask the agent for delegate certificates which would entitle them to reduced return fare.

The following persons were elected to active membership in

the Association : W. J. Clarke, Bell Telephone Co., Toronto ; W. B. Evans, Alex. Stark, Bell Telephone Co., Toronto ; James P. McQuaide, National Conduit Co., New York ; A. T. Smith, Bell Telephone Co., Kingston ; J. C. McLachlan, Bell Telephone Co., Hamilton ; Samuel Gardiner, Electric Light and Power Co., Hamilton ; Frank Badger, Royal Electric Co., Montreal ; W. M. Goodwin, G.T.R., Hamilton ; C. J. Leslie, Bell Telephone Co., St. Catharines ; Samuel J. T. Brown, Bell Telephone Co., London ; G. L. Shaeffer, Bell Telephone Co., Hamilton ; George Black, G.N.W. Telegraph Co., Hamilton ; G. C. Stannard, Construction and Electrical Supply Co., Toronto ; W. G. Fraser, Bell Telephone Co., Petrolea.

The following persons were elected as Associate members : D. T. Symons, barrister, Toronto ; Herbert Beaumont, Engineering Department Toronto Water Works ; G. J. Kilpin, Toronto; T. J. Carroll, Brass Mfg. Co., Hamilton ; K. Whipple, Hamilton ; Geo. W. Sadler, Montreal ; W. J. Duckworth, Toronto ; W. T. Brown, W. T. Walker, Galt ; F. G. Proutt, Electric Light Co., Bowmanville ; W. J. Jones, Hamilton.

The President was deputed to secure a suitable design for a certificate of membership.

Messrs. Thomson, Wadland and Dunstan were appointed a committee to endeavor to make arrangements for an excursion to and luncheon and band concert at Burlington Beach on the evening of Wednesday, June 15th.

The Toronto members of the Executive were authorized to choose a design for a members' badge and purchase the requisite number of badges. An outline of the order of proceedings of the Convention was decided upon as follows :

Tuesday, 14th.—11 a.m., meeting of the Executive. 2:30 p.m., —Opening session. Election of officers. President's address. 8 p.m.—Inspection of Electric Light Co.'s new station.

Wednesday, 15th.—10 a.m. to 12:30 p.m., reading of papers and discussions thereon. 2 to 3 p.m., visit to Bell Telephone Exchange. 7:30 p.m., trip by boat to Burlington Beach ; luncheon at Ocean House.

Thursday, 16th.—Reading of papers, discussion, business, etc. 2 p.m., Drive.

It was resolved on motion of Mr. Smith that the Hamilton members of the Executive associated with the Managers of the Great North Western Telegraph Co. and Bell Telephone Co., be a committee on invitations.



James Street North, Hamilton.



Hamilton Bay.

REQUIREMENTS OF A PERFECT STEAM BOILER.

1. The best materials sanctioned by use, simple in construction, perfect in workmanship, durable in use, and not likely to require early repairs.

2. A mud drum to receive all impurities deposited from the water, in a place removed from the action of the fire.

3. A steam and water capacity sufficient to prevent any fluctuation in pressure or water level.

4. A large water surface for the disengagement of the steam from the water, in order to prevent foaming.

5. A constant and thorough circulation of water throughout the boiler, so as maintain all parts at one temperature.

6. The water-space divided into sections so arranged that should any section give out, no general explosion can occur, and the destructive effects will be confined to the simple escape of the contents ; with large and free passages between the different sections, to equalize the water-line and pressure in all.

7. A great excess of strength over any legitimate strain, constructed so as not to be liable to be strained by unequal expansion, and no joints exposed to the direct action of the fire.

8. A combustion-chamber so arranged that the combustion of the gases commenced in the furnace may be completed before their escape by the chimney.

9. The heating surface as nearly as possible, at right angles to the current of heated gases, so as to break up the currents and extract the entire available heat therefrom.

10. All parts readily accessible for cleaning and repairs. This is the greatest importance as regards safety and economy.

11. Proportioned to the work to be done, and capable of working to its full rated capacity with the highest economy.—*Steam.*

WORK AND POWER AS MEASURED BY THE STEAM ENGINE INDICATOR.

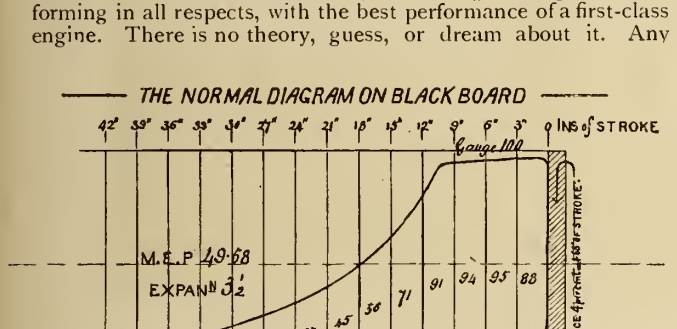
(Continued from May Number.)

Of late years an instrument called the Planimeter has come into general use, for determining the M.E.P. of diagrams. In this form of it, it only gives the area of a diagram in square inches, and to the second decimal. Here its work ceases, and you must divide the area by the length—the quotient multiplied by the scale is the M.E.P. correct to the second decimal.

In Crosby's instrument, you set the instrument to the length of the diagram. After running the tracing point around the diagram, the reading of the wheel, if it began at 0, is the mean effective pressure to a scale of 40. If the scale is any other, then it is computed from 40. This instrument only goes to the first decimal.

The Coffin averager, has a moving pole. After going round the diagram and starting from the extreme right of the diagram, the tracing point is moved upward on a perpendicular line until the reading of the wheel is the same as at the beginning. The scale length from this point to the starting point, is the M.E.P. of the diagram. All of these instruments are expeditious in use and wonderfully correct, but their price puts them beyond the reach of a good many. I am acquainted with mechanical means for solving this same question, without making a figure or calculation of any kind mental or otherwise, that in quickness is away ahead of Amstler's Planimeter, and in accuracy superior I believe to the Coffin averager. If time permits, and you are not tired out before I get through, I will show you how it is done.

For illustrative purposes on this occasion a real diagram would be useless. You could not see it, and to overcome this I have laid out on the black board, an enlarged diagram, conforming in all respects, with the best performance of a first-class engine. There is no theory, guess, or dream about it. Any



automatic engine with cylinder steam jacketed on barrel and ends, piston and valves steam-tight, all parts in proper proportion, and with boiler, steam pipe, stop valve and cylinder, in all of its parts, and outside of the steam jacket, completely protected from loss of heat, would produce, with an expansion of 3½ times, such a diagram as this. Of course our cylinder is 16″x 42″, making 70 revolutions per minute, and a pressure by gauge of 100. On this large sized diagram I have used a scale of 4, or ¼ inch rise of the pencil per pound of pressure, and made it 42 inches long, the actual length of stroke, and I have divided it into 14 equal parts of 3 inches each, 14 being the first number above and including 10 that divides the length of stroke, without a fraction in the quotient. This makes it handy. By merely looking at the diagram, I can see that complete cut-off has taken place at 11 inches of the stroke, and that the exhaust port opened 3″ previous to the end of stroke, and on the return stroke it closed at 3″ previous to the end of the stroke, and followed by what is known as cushioning or compression.

On arrival at the end of the stroke the pressure due to compression has risen to 22 lbs. above atmospheric pressure, when it is evident that the steam valve has opened the passage, and the pressure jumps up to 98.

At this point the stroke from that end of the cylinder begins, the port is kept open, and in fact the opening is gradually increasing in area until in this case at 9½ inches of the stroke tripping or disengagement takes place, and at 11 inches of the stroke the valve has completely closed the communication with the boiler, and expansion of the steam then imprisoned in the cylinder follows. At the 39th inch of the strike, the exhaust port opens, a sudden drop of pressure takes place, and after the piston has finished the stroke, and is fairly started on its journey back, it sobers down to a uniform back or exhaust pressure of 1½ lbs. to the square inch, until cushioning is again set up—and so on, as long as the engine is working.

I will now measure this diagram in order to find the mean effective pressure. I have already done it with my foot rule, in order to save your time, in sitting looking at me while doing it, and the number of ¼ in. in the mean height of each 3″ division, I found as follows:—88, 95, 94, 91, 71, 56, 45, 37, 30, 25, 21½, 17½, 14½ and 10. These amounts added together, give a total of 695½, which divided by 14 (the number of equal parts that the diagram is divided into), gives a quotient, 49.68, of which is the M.E.P. in pounds per square inch of this particular diagram on a scale of 4, and here our power constant of 3 comes in. This M.E.P. of 49.68 multiplied by 3 gives us 149 HP. being the rate of work done by our 16″ x 42″ engine under conditions as per diagram.

As we all know, this means that a constant pressure of 49.68 lbs. per square inch, acting on the face of the piston during the whole stroke, would do the same amount of work done by the varying pressures in the diagram.

At this point an important question arises that I have often heard asked by young engineers and by old ones too for that part, and likely the same query has arisen in some form or another in the mind of nearly every person present.

The work done by the varying pressures in that diagram ranging from 95 to 10 is equivalent to a uniform pressure during the whole stroke, of 49.68, or say 50 in round numbers—why would it not be as effective and economical to use a plain slide valve engine, without lap, and carry a uniform pressure of 50 lbs. during the whole stroke, and do away with all the whim whams and gimcracks of dashpots, springs, weights, trip gear, multiplicity of valves, and so on?

This is an honest straightforward question, and is entitled to a direct answer. In conjunction with the diagram, we are indebted to a Frenchman, Henry Victor Regnault for a direct, easy and true solution of this very important question. Between 1845 and 1850 he was instructed by the French government to make investigations and establish numerical data bearing on calculations connected with the working of steam engines. Regnault was well adapted for such work. He was a professional chemist and experimentalist, and had the mechanical ability for contriving means for the solution of such questions. After several years close application he finished the work; and the French Government with that liberality so characteristic of it in scientific affairs, gave the results to the world free.

As I stated before, the piston and cylinder of an engine at work, in reality perform the functions of a meter. Every stroke she discharges a uniform volume of steam, which volume is equal to the piston displacement during a stroke, and the pressure at which discharge or exhaust takes place is measured on the diagram, and in all cases must be measured from a perfect vacuum, which by common consent is 14¾ lbs. below the atmospheric line on the diagram. If great accuracy is required then the true position of the vacuum line is obtained from the height of the barometer when the diagram was taken.

And now when these preliminaries are through with, I will answer the previous question. By a former calculation I found that the piston displacement or displacement constant of our 16 x 42 inch engine, making 70 revs. per min. was 41050 cubic feet per hour, and this is also the volume of steam discharged in that time. Next I measure the terminal pressure of the expansion or automatic diagram, and find it to be 28 lbs. I next refer to Regnault's tables, and find that 14.37 cubic feet of steam at a total pressure of 28 lbs. per square inch weighs one pound. Here is what we are looking for. The total volume of steam per hour, 41050 cubic feet, divided by 14.37 the number of cubic feet in a pound, gives for answer 2856 pounds of water in the form of steam as having passed through the cylinder in one hour as accounted for by the indicator. But our engine has worked during that time at the rate of 149 HP. Dividing 2856 by 149, we get 19 1/5 pounds of steam accounted for by diagram, per HP. per hour. So far I have paid no attention to cylinder clearance; it is down on the diagram as 4 per cent. or 1/25 part of the stroke. Leaving cushioning out of the question this will have the effect of adding 1/25 or 4 per cent. to 19 1/5, bringing it very close to 20, which amount I accept as the water equivalent of our diagram per HP. per hour.

We will now take up the case of the M.E.P. being carried the whole stroke, and see what the results are, the piston displacement being the same. The terminal pressure must be measured from a vacuum, and in this case it is 49.68 x 14.7, or a little over 64 lbs. according to Regnault's tables 6.6 cubic feet of steam at a total pressure of 64 lbs. weigh one pound. As before dividing the constant 41050 by 6.6 we get for answer 6220 pounds of steam passing through the cylinder per hour, and delivering 149 H.P., the same rate as in the expansion engine. Dividing 6220 by 149 as before, we get a rate of 41.7 lbs of steam per HP., per hour, accounted for by the indicator, to which we add as in the first case 4 per cent. for clearance, we finally get 43 lbs. which is the water equivalent of our non-expansive engine, per H.P. per hour. For every 20 lbs. of steam discharged by the automatic engine 43 is discharged by the non-expansive engine in delivering 149 HP., with the necessary consequence that more than twice as much fuel is burnt on the grate to generate 43. lbs of steam, than it takes to generate 20.

It is in this manner that the economical performance of engines are compared—slide valve, automatic, condensing, non-condensing or compound, are all subject to one general principle rule or law, that the lower the terminal pressure of a diagram is, relative to the M.E.P., the greater is the economy of the engine. This is a truth common to all engines, yet it has a limit, steam obeys laws in expansion, and if the pressure falls below the amount due to that grade of expansion, it is proof of loss, either by condensation or leakage. A performance in

* Paper read at at a recent meeting of Montreal Branch No. 1, C. A. S. E.

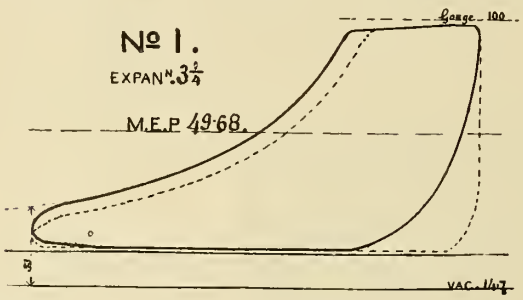
apparent defiance of all rule and decency, is the behaviour of a non-condensing engine when loaded very, very light, and the expansion curve drops below the atmospheric line. This is the most pernicious evil that can afflict an engine. I know an automatic engine in this city, and a good one, too, that owing to light loading, the indicator accounts, for a consumption of from 75 to 80 lbs of water, per HP. per hour, a rate nearly twice as high as the ordinary slide valve engine, and on the other hand an automatic engine overloaded and going so slow that she does not trip, degenerates at once to a common slide valve engine of a very poor class. This shows the importance of an engine being sized to fit the amount of work she is expected to do.

It is best for an engineer to train himself to the idea, that work on an indicator diagram is represented by a space of two dimensions, or an area, which it really is. The planimeter measures the area in square inches, and by a subsequent process the M. E. P. is obtained. The same thing is done, by ordinating, it is really measuring the mean height by the scale of the spring used. Any increase or decrease of the area of diagram, is accompanied with a corresponding increase or decrease of the work done. When this idea is mastered, it is surprising what results it leads to, and what an advantage it gives us in matters connected with engines, that are otherwise very obscure. Take our 16″ engine ; this diagram fairly cuts off at quarter stroke. Now it so happens that the scale line representing the M.E.P. fairly divides into two equal parts the space contained in the rectangle, bounded by the atmospheric line, the line of boiler pressure, and the two ordinates bounding the length of the diagram. It is evident then, that the space in the rectangle which is outside of the diagram, is equal to the area of the diagram. Now, dropping the niceties of the question, we see at once that if we carry steam full stroke and maintain a speed of 70 we double the work done at an expenditure of nearly 4 times the weight of steam. In engineering inquiries of this sort it is necessary in the first place to proceed on the assumption that no losses or resistance of any kind take place, afterwards these losses and resistances are determined and subtracted.

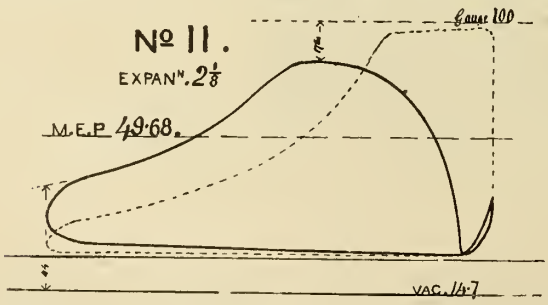
From actual diagrams taken in this city from automatic engines, carrying steam to nearly full stroke, the losses due to drop of pressure between boiler and cylinder, the fact that the admission port was closed before the end of the stroke and a slight expansion took place, the behaviour of the steam during exhaust with the consequent high back pressure during the return stroke, and the necessary loss of speed in the engine to cause non-tripping, amounted to 30 per cent. This brings our engine down to 208 HP. when carrying steam to the greatest possible extent and making 64 revolutions per minute and with boiler pressure of 100 lbs.—only a gain of 59 H.P. above that obtained when cutting off at quarter stroke.

I have examined this diagram on the black board, and find that the economical range of our 16″ engine with 100 in boiler is from 70 to 170 HP. Above 170 HP., the weight of steam used is beyond all proportion to the work done, and below 70 H.P. other causes set in that would ruin the performance at once.

Some engineers have a strange habit of attempting to govern the engine themselves. I have observed that they never have

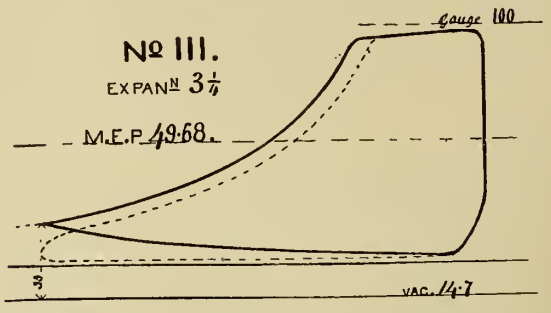


the throttle valve wide open, and from some cause that I could not perceive, they were continually turning the hand wheel a little inwards or outwards. What is the result? By obstructing the free flow of steam to the cylinder you lower the pressure during admission, with the necessary result that the steam is

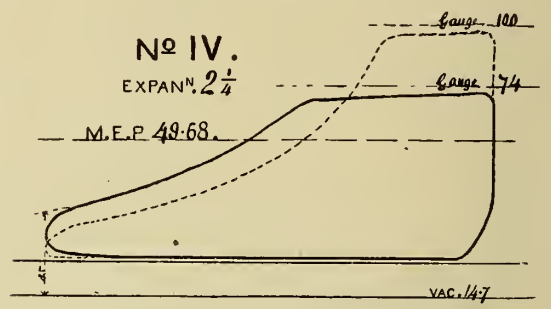


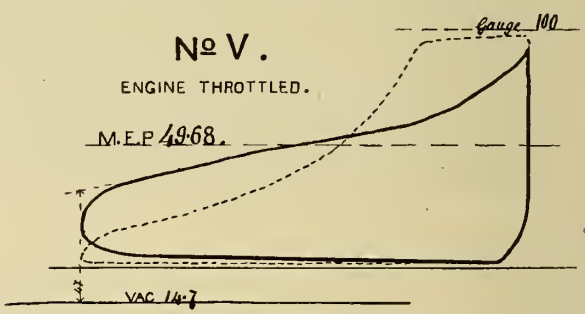
carried further in the stroke, and the stroke is finished with a higher terminal pressure—a loss that can be made out in dollars and cents if required.

The immediate effect of all defects in valve gear, such as admission of steam too early or too late, or lateness of exhaust and consequent high back pressure, or excessive cushioning is a reduction in area of the diagram, which means a reduced M.E.P. and a consequent slowing of the engine ; then the weights of the

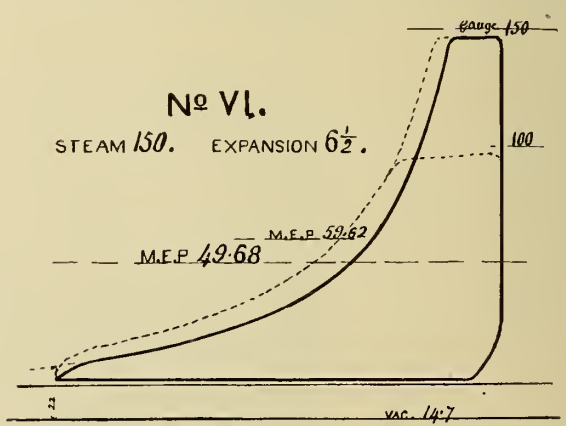


governor take a lower position, and steam is carried further in the stroke, with the necessary result that the terminal pressure is raised, or in other words, a greater weight of steam is used per stroke.





It is said that high pressures are conducive to economy. This is doubly true, but how does it arise? The scientific man explains it by the increased heat energy of the steam which is got so cheaply. The indicator gives the cause in a graphic manner that we can understand. Referring to our diagram on the black board : steam in boiler 100 ; cut-off quarter stroke, actual expansion 3½ times ; terminal pressure 28 lbs.; M.E.P. 49.68 ; H.P. 149. Suppose we have steam in boiler at 150 by



gauge, this has the effect of raising the steam line on our diagram 12½ inches higher, on a scale of ¼ inch to the pound. There we have it at sight. The increased work done, is in proportion to the additional area inclosed, relative to the original diagram ; and mark this, the expansion line in the added part is an extension of the original, and the stroke would be finished with a higher M.E.P., but the terminal pressure remains the same—28 lbs.—and there is no extra weight of steam in the cylinder.

But in this case we only require a M.E.P. of 49.68 lbs. to deliver 149 HP. The forces now acting on the engine are not in balance, and she starts off at a quicker speed ; the governor weights fly out, cut-off takes place earlier in the stroke, and the consequence is, that another expansion curve is described by the indicator, below the original, and the stroke is finished at a lower terminal pressure, or with a less weight of steam in the cylinder, and hence the economy of high pressure steam, which

in this case can be computed from either end of the diagram—on the steam end, from the decrease of the period of admission, and on the exhaust end, from the lowering of the terminal.

When I commenced to write this paper it was my intention to examine in detail a subject of importance in steam engineering that in a mysterious manner affects the economical working of engines. But I found that the limit of time allowed to the reading of a paper would be exceeded, and I abandoned it. But when I saw in your advertisement of this meeting , that a cordial invitation to attend was given to manufacturers, I thought it best before closing to call attention to it, because it is to them that we must look for the means of removing or reducing the loss.

The subject is complicated, but understood by those engineers that have turned their attention to it and verified their observations by the indicator, a foot rule and a platform scale. You will remember that in ascertaining the comparative economy between an expansion and a non-expansion engine, after arriving at the figures 20 and 43, I suddenly dropped it. All right so far, but that is not the end of it.

It is a fact that when tests are carried out as they should be, the difference between the steam or water accounted for by the indicator and the actual water fed to the boiler, is generally enormous. It may then reasonably be asked, what is the value of indicator deductions when such a difference exists in the actual quantity fed and weighed or measured in front of the boiler?

The indicator puts a numerical value on the loss. It is the duty of the engineer to discover the cause or causes, and remove them if possible, subject to the contingency that his employer is willing to furnish the means. A case took place in this city about a year and a half ago, the details of which came under my observation. A contracting engineer offered to make certain changes in an engine which would cost him several thousand dollars, and accept in payment the saving in fuel effected for a period of 425 day's work, say one year and a quarter. The proposal was accepted. This matter, of course, was talked about. The contractor was laughed, at men paid salaries of thousands a year expressed unfavorable opinions, and one of them, apparently in seriousness, asked me if I did not think that softening of the brain was a factor in the transaction.

But the contracting engineer was right ; he did his work, and was well paid. What he did (divested of all obscurity) was to increase the ratio of expansion, decrease the amount of water which disappeared from the boiler and was not accounted for by the indicator as elastic and working steam in the cylinder, and add a condenser, effecting a saving in fuel alone of over $6,000 per year on a basis of 300 horse-power.

It would require a lengthy paper to do justice to the subject of the difference between the weight of steam accounted for by the indicator and the water fed to the boiler, but I will state some of the general results that have been observed. With a boiler of good steaming qualities, ample steam room and water surface, but unprotected from loss of heat, and steam pipe and cylinder perfectly naked, the indicator accounts for about one-half of the water fed to boiler, say 5 lbs in 10 feet. With boiler and steam pipe fairly well protected and barrel of cylinder cased in strips of wood only, 6½ lbs. is accounted for in 10 fed. With boiler and steam pipe clad in a superior manner and cylinder completely protected from loss of heat, both barrel and covers, and nothing exposed but the piston rod, from 8 to 8½ lbs. are accounted for per 10 fed. These are general results in ordinary practice ; anything better is obtained by the use of a steam jacket and slightly superheated steam.

I have lately read a report of some tests of engines made by Prof. Thurston ; however, nothing was done to get the weight of water fed to boilers. But in his report he added 30 per cent. to weight accounted for by indicator ; this is equivalent to 7.7 lbs. accounted for per 10 lbs. fed. If we add 30 per cent. to the 20 and 43 lbs. found in our 16″ engine when working at 149 H. P., we get 26 and 56, amounts that in practice will be found close. And with a boiler efficiency of 8 lbs. of water evaporated per lb. of coal burned on the grate, we obtain the following final result : Automatic engine, 3½ expansions, 3¼ lbs. of coal per H.P. per hour ; non-expansive engine, 7 pounds of coal per H.P. per hour.

PUMP NOTES.

In inserting a pump of any kind, every joint should be well wiped before putting together, in order to prevent dirt being between the compacting surface and hence impairing the tightness of the joints. All bolts and screws should be well oiled, or better yet, wiped with black lead and grease, before putting in. Then when the time comes for them to be backed out this can be done. For a similar reason, flange joints that are put together without rubber gaskets should be smeared with black lead and grease. Where rubber gaskets are used, one side, and one side only, should be rubbed with dry black lead, or with chalk, so that when the time comes to break the joint, the gasket will come off, entirely upon one flange, not part of it upon one and part on the other.

When a steam pump has been set up, the first thing done should be to blow steam though the steam end to see that all joints are tight and everything free that should be free. Blowing through to remove dirt should be done with the bonnets off if that can be done. Then the water side should be primed to see whether or not it is tight on the suction side. There should of course be a foot valve; and if there is any leak in the pipe or at the valve, that will be very readily detected in a short time. The suction valves should be tight under pressure of the full head of water that can be put upon them; so should the discharge valves; and these two sets can be tested after the foot valve is proved.

When all is connected properly, and shown to be, or made, tight, then the pump should be started up slowly under steam, if it is a steam pump ; and work gradually put upon it until it is doing full duty. It should be tested to a pressure and speed beyond that which will be required of it in its daily work.

A pump which is to be kept for a fire service only should be tested very often to see that every thing about it is in first class order and ready to go to work at five seconds' notice. "Very often" means not less than once a week. Fire pumps should have right at hand, everything that is needed to start them up, or to adjust them. Throttle valves or discharge valves should have wheels or levers which cannot be removed ; and all spanners or other things of that nature should be tied or chained in place, so that when wanted they will be right at hand and usable at once.

If a pump refuses to lift its water there may be any one of several things the matter with it. It may have a leaky suction pipe, or a leaky piston or plunger, or a leaky stuffing box, or a cocked valve, or one which is stuck shut; or the gaskets may be rotten; or if it is a new pump there may be somewhere a "blind joint" through which no water may pass. There may be a pocket of air in some hump in the suction pipe; the suction pipe may not have been primed; or the priming water may have leaked out by reason of a leaky suction pipe or of deficient foot valve.

Sometimes a pump will not start off well, even when the suction side is all right ; this may be by reason of its being "air bound ;" acondition of affairs that is very often remediable at once by opening a pet cock between the discharge valves and the air chamber. Sometimes indeed a pump may fail to pick up its water by reason of its being air bound on the discharge side.)

Some times a pump which does not draft well to start with may be made to catch its water by running it very fast so as not to give time enough for air to leak in, to spoil the suction. When it has got its water, it may keep on drawing well, although its capacity and its quietness of running, will be lessened by the influx of air with the suction water.

Special care should be taken with direct acting steam pumps not to let them suck wind, because if they do, there is liability of our knocking out a head.

Where there is liability of freezing, it is not safe to have a foot valve which can not be tripped so as to entirely clear the suction line ;and there should be a "bleeder" by which the pump itself may be drained thoroughly. Where the suction pipe is drained to prevent freezing, there should be extra facilities for priming ; and of course if the pump is for fire service that is especially the case ; for it may not do to have the water stand in it, and yet it must be brought right up to working capacity in a very short time; and if it will not draft its water without priming, it must be primed at once by sufficient flow of water to prevent the object of priming being defeated by leakage.

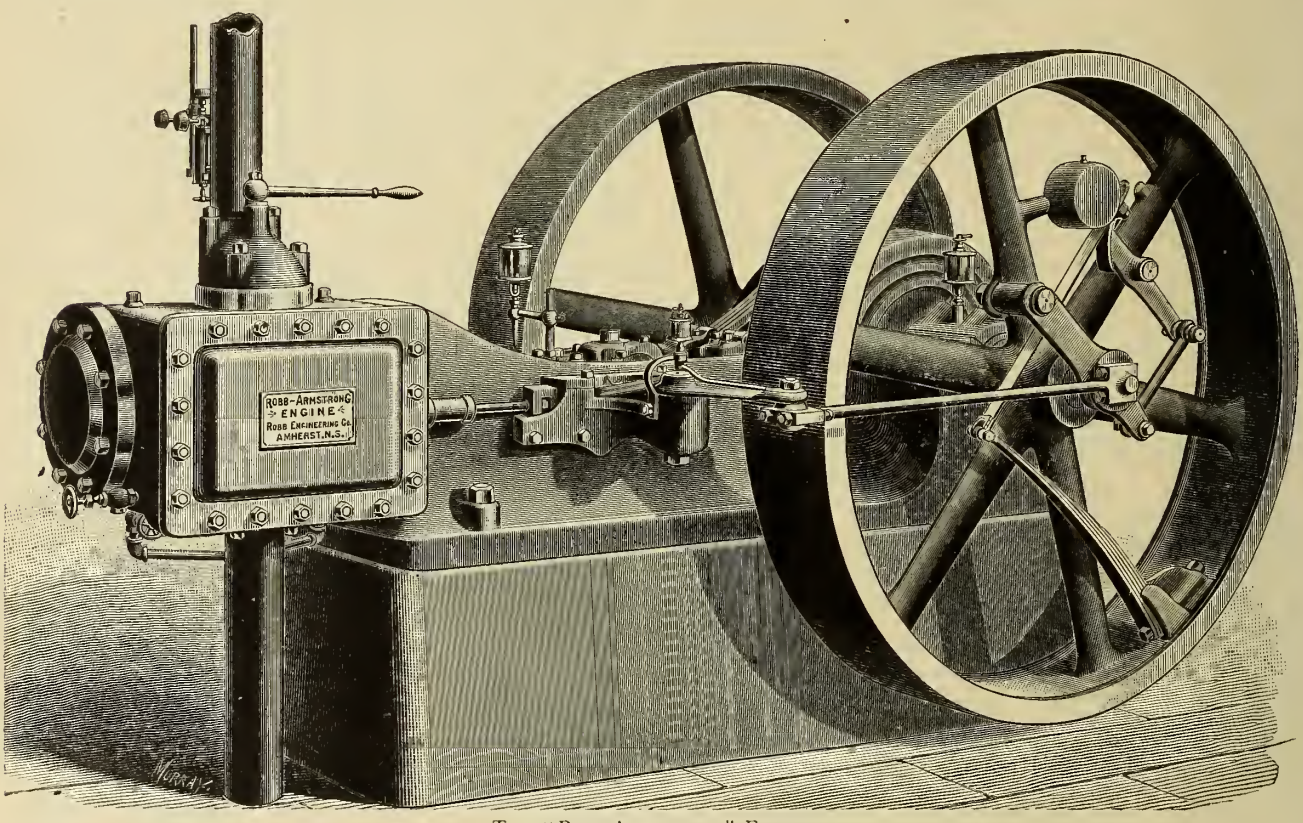
Pump buyers are not sufficiently careful or well posted in choosing ; they will buy a centrifugal pump for service where a piston pump is needed ; will put a pump that has small poppet valves, closed by springs, at work pumping material that is full of stringy solids ; will buy a small fire pump for boiler feeding purposes, or set a brass pump to work on ammoniacal liquor, and so on. In ordering or in getting quotations, the pump buyer should state what the pump is to be used for ; if for more than one purpose, both or all should be stated ; the steam pressure available should be given ; and if this is likely to fall that fact should be stated also. The liquid to be pumped should be described ; whether clean or greasy, fresh, salt, alkaline, acid, muddy, full of bark and vegetable matter, or what ; and its temperature should be stated ; because some materials thicken up at low temperatures where they have to be drafted. The maximum amount that will be called for per hour, and the minimum amount that can be got along with, should be laid down ; and the pump maker or dealer should be told whether that amount must be delivered regularly, or whether it will do to run double speed or capacity for a while and stop the rest of the time. The maximum distance that the liquid must be drafted, the length, diameter and material of the suction pipe, and the number of bends, should be given. Then there should also be stated the maximum height to which the liquid is to be pumped, the length, diameter and material of the discharge pipe, and the number of ells or turns.—*Power and Transmission.*

Messrs. John Starr, Son & Co., of Halifax, in an advertisement in this number call attention to their lines of electrical goods, especially to the "Samson" battery the rights for which they control both in Canada and the United States. The sales of these batteries last year are understood to have amounted to over 60,000 cells. Their "Unique" telephone is claimed to have the only transmitter which does not require readjusting and is not affected by atmospheric changes, jarring, etc. This firm erected last fall a line for the Valley Telephone Co. of Middleton, N. S., 20 miles long with thirteen instruments in series, the satisfactory working of which has decided the company to undertake the construction of a trunk line, 85 miles long throughout the Annapolis Valley with exchanges at the different towns through which it will pass. The whole line will be completed in July. Connection will shortly be made through to Halifax.

THE "ROBB-ARMSTRONG" ENGINE.

We illustrate on this page a new single-valve automatic engine recently brought out by the Robb Engineering Co., of Amherst, Nova Scotia. In general appearance it does not differ greatly from several popular high-speed engines, and no radical departure has been made in principles of construction, the aim being to combine as many as possible of those points which have proven best in practice, with such improvements in details as have been suggested by observation and experience with other engines. In other words, it is not an attempt to develop a new species, but to advance one step in the evolution of that already highly developed machine, the American high-speed engine. The following is a brief description of the main features :

The frame is of the "Porter" type with double-disk crank ; it has considerable sectional area, carried well above the center line, and is particularly thick at the top, thus bringing the metal in the direct line of strains between the cylinder and shaft bearings. The engine weighs a little over one hundred pounds per horse-power, not an unusual weight, but the metal is distributed to give the greatest attainable stiffness, and without much regard to the "anvil principle," the foundation being expected to furnish all the weight required in that direction at less cost.



The "Robb-Armstrong" Engine.

The crank is "built up" of cast disks and forged steel pin and shafts, the peculiar arrangement of the crank permitting the fits of the shafts and pin in the disks to be very long, without separating the shaft bearings unduly, as is shown in the cross-section at the right of Fig. 2 ; the counter-weight is of equal moment with the reciprocating parts. The shaft bearings run in cast-iron shells, babbitted ; they are not provided with means of adjustment for wear. The bearings are finished by grinding operations of great delicacy, and are round and parallel within a limit of variation smaller than the average machinist will usually detect, even with the aid of the micrometer. The shafts are made to gauge, and the shells are interchangeable, as are the other parts of the engine ; hence, a duplicate set of shell may be kept for emergencies. The crank is covered by a cast-iron case shutting it completely in except at the slot through which the connecting rod works. The crank disks are without the usual finished flanges on the periphery, the crank case being designed to have a substantial and finished appearance, and free access is given to the crank-pin box, when the hinged crank case is raised. The crank-pin is oiled through two ½" holes, one extending from each side of the crank to the center of the crank-pin, all oil wasting from the inner ends of the shaft bearings being instantly carried to the crank, while all oil wasting from the outer ends of shaft bearings is caught, and by a ring riding on the top of shafts and dipping into the oil below, is returned again and again to the bearing, until it finds its way to the crank-pin and escapes to the crank pit, to be drawn of and filtered. In practice the crank-pin does not need oiling other than as stated, but a sight-feed oil cup is provided in addition to those oiling the shaft bearings, which will, if desired, feed oil direct to the crank-pin through one of the ½" holes before mentioned.

The fly-wheel governor is a modification of the "Straight Line," and, together with the valve, is used by arrangement with the Straight Line Engine Co. ; the oiling devices mentioned will also be recognized as essentially "Straight Line."

The eccentric rod, so called, although there is no eccentric, has ball and socket bearings at each end, the balls being case-hardened and ground, and the sockets or boxes of phosphor bronze. The rocker arm, by which the eccentric rod drives the valve, is horizontal, with a vertical axis ; there is no twisting strain on either of its bearings, a straight line passing through all three of them. An index finger attached to this arm, as shown in plan view, Fig. 3, shows, by the graduations over which it passes, the movement of the valve, and thus is of assistance in valve setting.—*American Machinist.*

TELEGRAPH COMPANY'S LIABILITY.

The following rulings regarding the liability of telegraph companies for negligence in failing to deliver telegrams were made by the Appellate Court of Indiana in the case of Western Union Telegraph Company vs. Newhouse, viz. : That telegraph companies, while not strictly common carriers, and therefore not subject to the same severe rules of responsibility, yet are to be held to a high degree of diligence, skill and care, and are responsible for any negligence or unfaithfulness in the transmisson and delivery of messages, that ordinarily the specification in the address of a message of some place for delivery is by way of assistance in making a personal delivery, and the company is not necessarily absolved by such designation of place from making further effort to find the person addressed, and it may be negligence to fail to do so ; that injury to the feelings occasioned by failure to deliver a message, unconnected with pecuniary loss or bodily injury, should be regarded as actual damage if the direct and proximate consequence of the negligence complained of, and that telegraph companies are liable for such negligence to the person to whom a message is addressed, as well as to the sender.

There are twenty-five telephones in use in the different establishments of the Rathbun Company at Deseronto, Ont. Over 80 electric wires converge to the general offices of the company.

PROPOSED BOARD OF ELECTRIC CONTROL.

FOLLOWING is the draft of a Bill to be submitted to the Dominion Parliament, reference to which is made in our editorial columns :

WHEREAS the use of electricity for power, heat and lighting, in all parts of the Dominion, is already common, is daily increasing and is likely to largely extend in the near future, and whereas in view of the dangers to life and property resulting from imperfections of design, defects in construction and imperfect insulation and maintenance of electric plant and installations are great, and whereas it is expedient that the power and intensity of the light supplied to the public by electricity for illuminating purposes, by municipalities, incorporated companies and individuals, and contracted for by meter or otherwise, should be subject to inspection and regulation in the common interest:—

THEREFORE, Her Majesty, by and with the advice and consent of the Senate and House of Commons of Canada, enacts as follows :—

1. The Governor in Council may appoint at such salaries as may be deemed proper, three persons, expert in the science, who shall be known as the Dominion Board of Electric Control, and who shall have the supervision of all plant and apparatus supplying or conveying electric energy throughout the Dominion as hereinafter provided.

2. Such Board may, in its official capacity administer oaths, issue subpœnas, and employ such assistance as will enable it to carry out the provisions of this act.

3. Subject to the approval of the Governor in Council, the said Board shall draw up rules and regulations for the insulation of electrical conductors, the mode of erecting poles for carrying same, and the manner of placing the conductors thereon, the character and construction of underground subways, and the placing of electrical conductors underground generally; the construction and placing of converters or trans formers the relation between the various classes of conductors, carrying currents of different descriptions in the same city, town or village; the adoption and use of reasonable safety devices and appliances, and generally regulating the construction, maintenance and repair of the plant and apparatus of municipalities, companies or individuals engaged in the business of distributing electricity for commercial purposes throughout the Dominion, in so far as may be necessary to secure the safety of the public as to life and property.

4. The Board shall have power to devise and carry into effect, either independently or with the aid of the local authorities, in cities of over 25,000 inhabitants, plans for the removal of overhead electrical conductors.

5. The Board shall hold semi-annual examinations at two or more convenient points, whereat persons desiring employment as electricians, electrical experts, engineers or linemen, shall be examined and certificates granted to such as may be found to be duly qualified and to be fit and proper persons to be employed in the business of distributing electricity for commercial purposes, the examinations to be conducted and certificates granted under rules to be drawn up and approved, as in the case of stationary and marine steam engineers, with due penalties provided for the employment of unlicensed persons in cases where any electrical energy is sold or disposed of for hire, or any beneficial consideration whatever, or where conductors are used passing at all along public streets or highways.

6. The Board shall be empowered to examine into the circumstances of any death or accident to person or property, caused by electric currents, on giving the corporations or persons concerned, due and reasonable notice to appear and be heard.

7. The Board shall cause to be inspected at least semi-annually, all installations and plant generating and distributing electrical energy for hire, and shall issue certificates that the same conform to the standard of rules and regulations for the public safety.

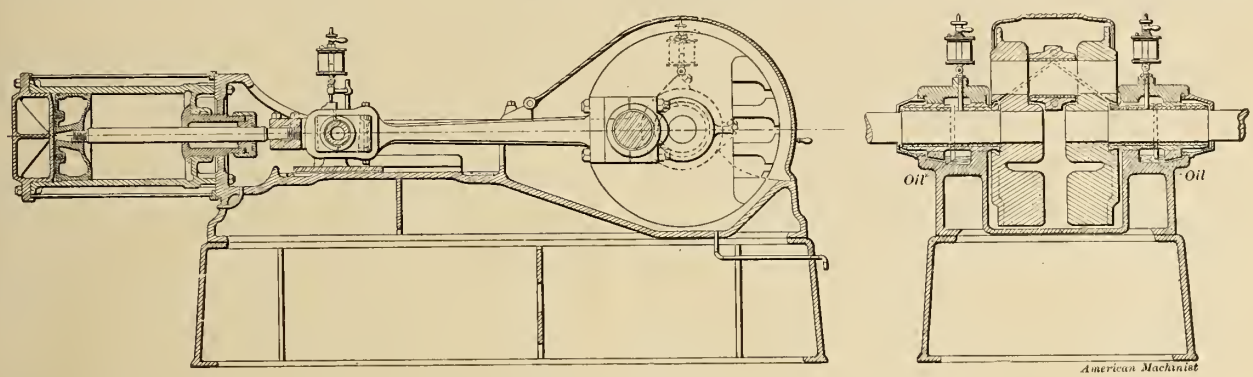
8. Any municipality, company or individual, supplying electrical energy for hire, or using electric conductors, passing at all along public highways or streets, without a certificate, as provided in section 7 hereof, shall be subject on proof, to a fine of $———which may be recovered in any Court of competent jurisdiction.

9. The Board shall cause to be examined, all meters and devices for registering the quantity of electric energy supplied by municipalities, companies or individuals for hire, and certify the same to be accurate, the provisions for renewal, etc., to be based on the Dominion Acts regulating the inspection of gas meters.

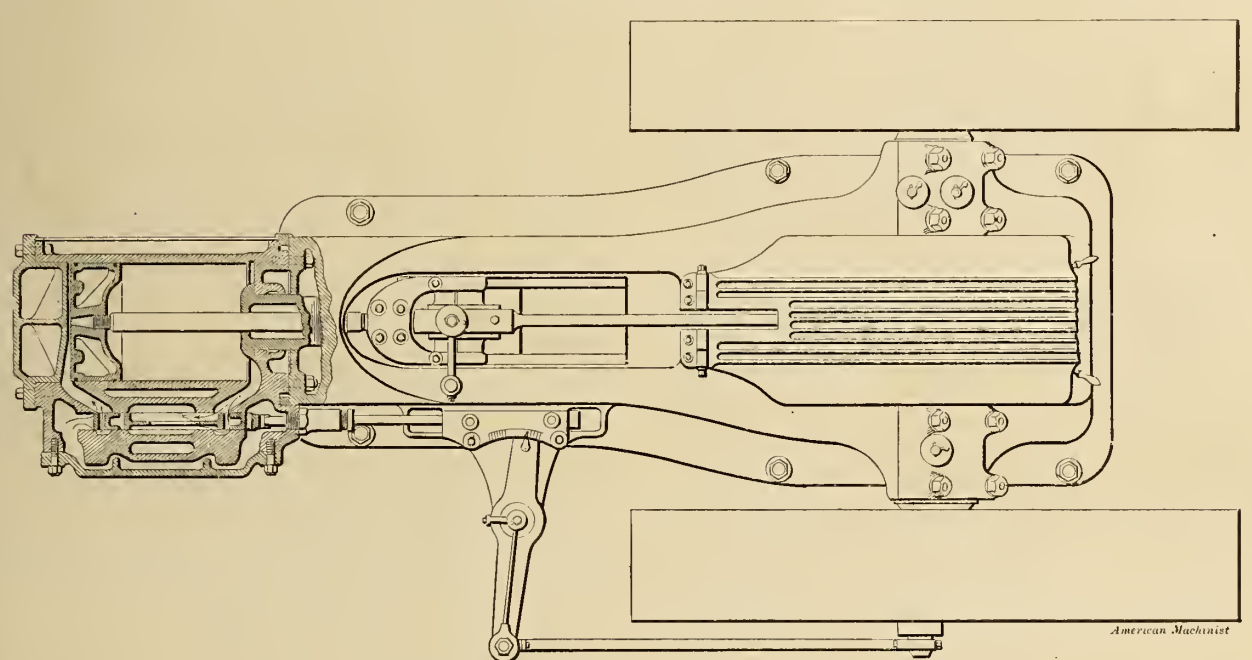
10. The Board shall provide for the periodic testing, in a proper and efficient manner, of the power and intensity of the light furnished by any municipality, company or individual for hire, or other consideration, and require the same to conform in every respect as regards illuminating power, to the standards laid down by Dominion laws for gas.

11. The words "electricity" and "electric energy" shall be construed as including all forms of electric or magnetic power or motion.

12. The annual expenses of the Board shall not exceed $———, and these expenses shall be borne and paid by the various companies engaged in the business of distributing electricity for commercial purposes within the Dominion, including all telephone and telegraph companies, companies distributing electricity for the purpose of furnishing heat, light and power, companies operating street cars or other public conveyances by means of electricity, district telegraph or messenger companies, and burglar alarm or fire alarm companies.



THE "ROBB-ARMSTRONG" ENGINE.—FIG. 2.



THE "ROBB-ARMSTRONG" ENGINE.—FIG. 3.

PUBLICATIONS.

The contents of the *Arena* for June embrace science, history, ethics, economics, politics, literary criticism, education, physchic science and fiction.

The Royal Electric Co., of Montreal, have issued an attractive book of testimonials, in which is expressed the good opinion of their apparatus entertained by customers who have had Royal plants in use for years.

We are indebted to the courtesy of the Secretary, Mr. Ralph W. Pope, for a copy of the transactions of the American Institute of Electrical Engineers from December, 1890, to December, 1891. The book, which is neatly enclosed in cloth covers, embraces nearly 700 pages, comprising papers and discussions on the important phases of electrical history and development. On the first page appears an excellent portrait of Prof. Elihu Thomson, the fifth president of the Institute. There is also printed a full list of the members and associate members of the Institute. The book contains numerous illustrations, and forms a valuable work of reference.

Jas. A. Wright, formerly general manager of the Federal Telephone Company at Montreal, has left this company to fill a similar position with the Maxwell General Supply Company of Toronto.

CANADIAN ELECTRICAL NEWS AND STEAM ENGINEERING JOURNAL

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The Publisher should be notified of the failure of subscribers to receive their papers promptly and regularly.

EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

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THE Order of Railroad Telegraphers, at its annual meeting in Chatanooga, Tenn., last month, resolved to hold next year's convention in Toronto, Ont.

IT was reported recently that a combination of the Westinghouse Co. and the firm of Siemens & Halske was about to be formed to oppose the Thomson-Houston-Edison concern. Messrs. Siemens & Halske deny however, that anything of the kind is in contemplation. Even in their separate capacity, the concerns mentioned should prove formidable competitors

THE mayor and a section of the Toronto City Council spent several months of valuable time and quite a sum of public money in finding out what everybody conversant with the subject knew beforehand, viz: that the overhead trolley is the only practicable method for the operation of electric street railways at the present time. Having at last made the discovery, the the Council has approved of the system, and the change to electricity will at once be proceeded with. It may be remarked in passing that the local storage battery company which announced its ability to do wonderful things, but neglected to give any practical proof of its *bona fides*, is now engaged in winding up its business.

THE amalgamation of the Edison General Electric Company and the Thomson-Houston Co. has been consummated. The officers of the new organization, which will be known as the General Electric Co., are as follows: President, Chas. A. Coffin, Boston, Mass.; first vice-president, Eugene Griffin, Boston, Mass; second vice-President, Samuel Insull, New York; Treasurer, A. S. Beves, New York; first assistant-treasurer, Gen. B. F. Peach, Jr., Boston, Mass.; second assistant-treasurer, W. F. Pope, Boston, Mass.; secretary, E. I. Garfield, Boston, Mass.; assistant-secretary, A. S. Beves, New York; comptroller, Jas. P. Ord, New York; auditor, Edward Clark, New York. The capital of the concern is $50,000,000.

WE have previously emphasized the fact that a most important part of the engineer's education in the future will relate to a knowledge of the principles of electric science and the construction and method of operating electric machines. In this opinion we are supported by *Electrical Enterprise* of Chicago, which says: "The rapid increase in the number of small isolated light stations is creating a demand for a class of skilled men of which the supply is very limited. We refer to engineers who are capable of taking charge of electric plants. The daily papers and technical press constantly contain advertisements asking for engineers with a knowledge of electricity. Here is a line of work that the trade schools of the country should give much more attention to. The demand is one that is constantly increasing, and an engineer with some practical knowledge of electrical machines is sure to find a ready demand for his services. The education of such men should be agitated much more than it is."

IF straws show which way the wind blows, and we believe it is generally conceded that they do, there can be no doubt but that in the patent recently granted to T. A. Edison by the U. S. Patent office, the Bell Telephone Co. will try to find an effective means of continuing the telephone monopoly in Yankee land for quite a number of years. Whether they will attempt this or not, remains to be seen, also whether they will make a success of it. We predict that the people would rise in their might, if such a thing were attempted. The Bell Telephone Co. may think discretion the better part of valor in this case, let well enough alone, and try to prevent competition on the expiration of their patents in 1893, by efficient service, at such prices as will pay their shareholders but a small interest on their investment. They have possession now, which in itself gives them a mighty advantage. By giving cheap rates and the best of service, they need fear no opposition. Here in this Canada of ours we are lucky in having our telephone service at a cheap rate, and as a general thing it is a good one. It would not pay an opposition telephone company to start business in Canada and expect to make money, for we know that the business throughout the Dominion is being conducted on a

barely paying basis ; nevertheless if the telephone patents were any good on this side of the line, things might be somewhat different.

As most of our readers are no doubt aware, the proposed consolidation of the Edison and Thomson-Houston Electric Companies in the U. S. has now become an established fact, under the name of the General Electric Co. It seems to us that since the names of Edison and Thomson have been associated with electric lighting almost from the start, it would have been better to have named the concern either the Edison-Thomson-Houston Co. or The Thomson-Houston-Edison Co. As it now stands, it will be necessary for the company's agents when trying to sell a plant to some party or parties who do not keep themselves posted in the concerns of electrical companies, to state the fact that they are selling T. H. or Edison apparatus, and just here we venture to say they will meet with individuals who will doubt their being in a position to supply such apparatus and who will still be on the look out for the Thomson-Houston or the Edison man to come along to sell them their desired machinery, whereas if they were representing a company whose name was that of the apparatus they were supplying, the agent, would have less trouble in selling his wares. There can be no doubt, however, that the ultimate object of The General Electric Co. will be to absorb all the other existing electrical manufacturing companies of any size and who might become active competitors. We have it from reliable authority that there will be no immediate change made in the affairs of either the Edison or T-H. companies in Canada, but that each will hoe its own row as heretofore.

On another page will be found the text of a Bill proposed to be introduced in the Dominion Parliament with the alleged object of safeguarding in the public interest the conduct of electrical enterprises. The Bill provides for the appointment of three persons to act as a Board of Electric Control. This Board is to compel all persons engaging in electrical pursuits to undergo examination as to their efficiency; to inspect all electrical plant in use throughout the Dominion, and see that the same is of proper quality and rightly installed. The Bill provides that in cities with upwards of 25,000 population all wires must go underground. Finally it provides that the cost of all this "regulation" of the business shall be borne by the electric companies. The Bill, which is evidently inspired by some of the gas companies, is unjust, unworkable and unnecessary. The use of electricity in Canada has not been marked by many accidents nor given rise to much damage by fire. In Toronto, the accidents from this cause have been almost nil, while the total loss by fire traceable to electricity has been the sum of $8. With a record such as this in an electrical centre like Toronto, there is surely no cause for alarm for the public safety, or to saddle the electric companies with a burden of needless annoyance and expense. As regards the proposed Board of Control, it would be impossible for any three persons to perform the duties assigned to them by the Bill. The work would require the constant attention of more than half a dozen inspectors, and the cost, in a country of such wide extent, would be enormous. The inevitable result of imposing such expense on the electric companies would be to largely increase the cost to the purchasers of electric light, telegraph and telephone privileges, and to drive into bankruptcy many of the smaller electrical concerns. The Bill should receive the strongest possible opposition of all engaged in the electrical business as well as of purchasers of electric current.

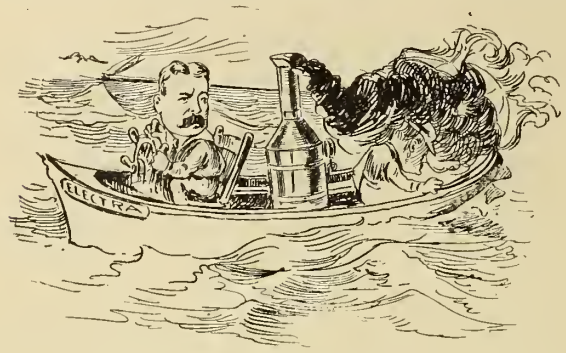
We are in receipt of a letter from one of our subscribers in the far North West who suggests that it would perhaps benefit a number of our subscribers, were we to have a series of articles written giving practical directions for the construction of the different classes of dynamos in use at the present time. This would involve our writing a book, and could not be done in a series of articles without covering a long period of time, particularly as the Electrical News is only published once a month. We therefore take pleasure in referring those who are desirous of becoming familiar with the different classes of dynamos and principles of their construction, to our editorial in this issue giving a list of books which teach these very subjects, and which, if followed out, will result beneficially to all who are seekers after this particular knowledge, and may be the means of giving them a more thorough insight into minor details that to a certain extent are surrounded by mystery to them at the present time. The same subscriber suggests that an article on house wiring might be beneficial to some of our readers, and as this is a subject that admits of an occasional article explaining the different methods and ways of doing incandescent wiring, we take pleasure in announcing that we will in the near future arrange for a series of articles on this subject, which we hope will be both beneficial to our subscribers, and ourselves—to our subscribers, or some of them, in the increased knowledge they will possess on this subject, and to ourselves in the increased number of subscribers our efforts in that direction may bring to us. It gives us much pleasure to be the recipient of communications from our subscribers similar to the one above, and it will always be our aim to enlighten them as much as possible on any subject they may suggest, for we know there must always be many others desirous of obtaining knowledge similar to that sought by the party who asks the question. We are pleased to see that the News is thought of when perplexing questions relating to any electrical subject suggest themselves to our readers.

We are asked by some of our subsribers to give the names of books on electricity which would aid them in getting more of an insight and knowledge of the subject. While it is almost an impossibility for a person to become a thorough and practical electrician without that drilling which one gets in a large electrical manufacturing establishment or in a school where it is taught, yet we feel sure that if the course we point out here is followed with the earnest determination on the part of the student to learn as much as possible, and with a close devotion to the teaching of the different works here enumerated, it will at least start him on the right path. To those who desire to start at the A. B. C. of electricity we cannot recommend a better work than "The Elements of Electric Lighting," and "The Elements of Dynamic Electricity," both by Atkinson, containing as they do the preliminary knowledge necessary for a person who is desirous of advancing in the science. After this has been mastered then let the student take Prescott's "Dynamo Electricity," digest its contents, and make sure that its principal points are committed to memory. For the electric light man the next book in order, and one which will tell him what a dynamo is and how it is made, and why it performs its functions, will be Hering's "Dynamo Electric Machines." Just here we may say, that there is no better book published than this one for the use of the student and dynamo engineer ; it gives in plain and untechnical terms and language what every man who has anything to do with dynamos should know ; it describes in a thorough manner all the different forms of armatures, giving diagrams of the different windings, with explanation as to why they are wound so, nor does it neglect the fields, but shows in a practical and easily understood way what are the good points and what the bad about the different shapes and arrangements of fields and their windings. We therefore cannot commend it too highly to those who have sufficient preliminary knowledge to enable them to grasp its teaching. Plain language is used wherever possible and only in one small part are algebraic forms resorted to, and there they are an absolute necessity and cannot well be omitted. Its explanations are well worded and easily understood. We cannot, we think, conclude this article in a better way than by saying to those who desire to delve still deeper into the art, that Sylvanus P. Thompson's "Dynamo Electric Machinery" is the one book that an advanced student must make himself familiar with. True, it contains terms and language that cannot be understood by one who is just starting out in the study of electric lighting, yet there is a good part of it devoted to the practical, every-day explanation of the dynamo and its application in all its forms, and it is a well known fact that there is no other work published that practically explains the Thomson-Houston arc dynamo and its commutator and three coil armature better or more thoroughly. We hope we have mapped out a line of study in the above that will serve to guide those who are seekers after electrical knowledge ; we might add that no matter who the man is, how much he may know, or think he knows, there is still room for more knowledge, and it should be

every electrician's object to try and learn more and more every day about the science ; by doing so he makes himself more valuable to his employer and betters his position in every way.

THE C. E. A. CONVENTION.

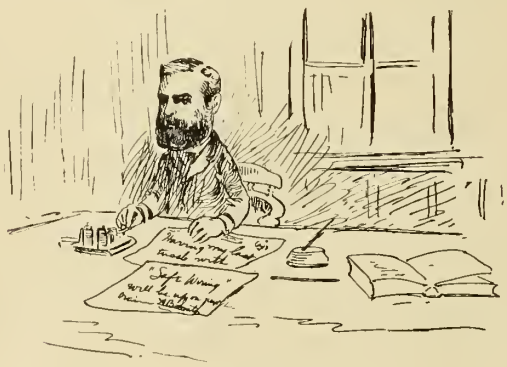
On another page we print the programme for the first annual Convention of the Canadian Electrical Association to be held in Hamilton, on the 14th, 15th and 16th inst. The arrangements for this Convention are now almost complete, and are of a very



THE PRESIDENT HEADING FOR HAMILTON.

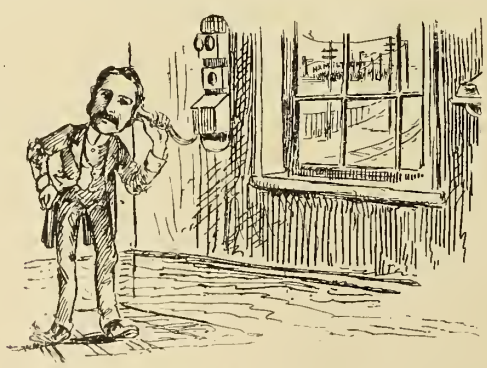
satisfactory character. The programme, as will be seen, is a most interesting one ; the papers to be read relate to almost every department of electrical work, and the authors are men whose long and varied experience should give to their opinions great importance. It is hoped that the discussion of these papers will be of the fullest possible character, and prove quite as interesting and instructive as the papers themselves.

The officers of the Association have devoted a great deal of attention to the arrangements for this meeting, and it now remains



for the members to do their part, by making a point of being present at the Convention even if necessary at some personal sacrifice. Each one should come with the determination to do all that he can individually, to promote and secure the success of the meeting.

It is very desirable that every member should take part in the proceedings, and assist in stimulating discussion instead of leaving the business to be done by a few. If every member will come prepared to ask questions and impart such information as



FOR THE EXCHANGE OF IDEAS, NOTHING CAN BEAT THE LONG-DISTANCE TELEPHONE—EXCEPT THE ELECTRICAL CONVENTION.

his experience may have afforded him, the occasion cannot be other than a profitable one to all who may attend.

It is the desire of the president and officers that every thing should be done as informally as possible, that the fullest opportunity may be given for the members to become personally acquainted with each other, and that every body should feel free to take part in the proceedings, and share in the enjoyment of the social features of the occasion.

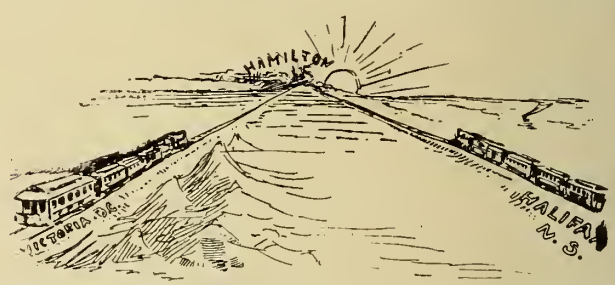
After having had communication on the subject with the manufacturers of electrical apparatus, the Executive of the Association have come to the conclusion that it would not be wise for the Association to attempt to hold an exhibition in connection with this first annual convention, but rather to devote



"WHAT I KNOW ABOUT CONVENTIONS!"—J. CARROLL.

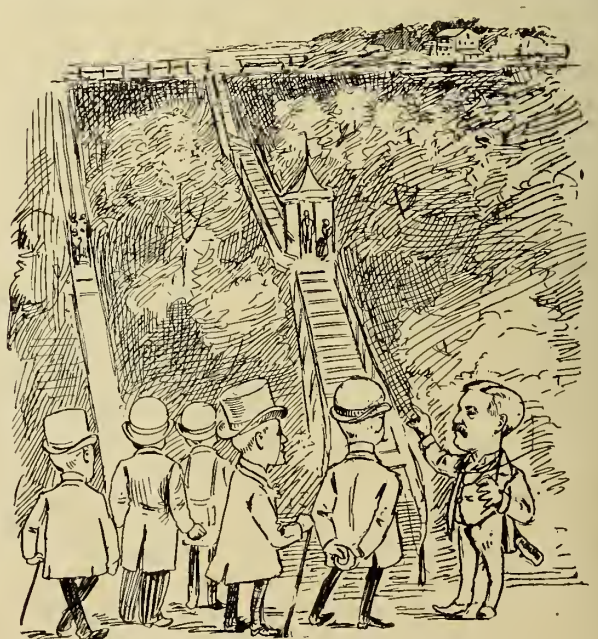
their entire attention to placing the Association on as favorable a footing as possible.

The management of the Toronto Industrial Exhibition have signified their desire that the Association should hold an exhibition in connection with the Industrial. In view of this it has been thought best to postpone any thing of this kind until the time of the Toronto Industrial Exhibition of 1893. By that time



the membership it is hoped will have largely increased, the Association will have become in every way better established, and all the necessary facilities will be afforded for the holding of a creditable exhibition.

The growth of the Association, thus far, has been very satisfactory. It stands in a much better position than did the National Electric Light Association of the United States, at a similar period in its history. Its membership will soon have



THE VISITORS ARE ASKED TO BEHOLD THE MOUNTAIN!

reached one hundred, and included in it are representatives of electrical interests residing as far east as Halifax, and west to Victoria B. C. That there is need for the existence of an Association of this kind, there can be no doubt. The electrical interests are growing at an exceedingly rapid rate, and it is only

by means of organization that the rights of these important interests can be conserved. There is at the present time, an attempt being made to secure the passage through Parliament, of a Bill, which would, to a great extent cripple the electrical business of the country. As soon as it became known that such a movement was on foot, the President of the Canadian Electrical Association caused a circular to be sent to all persons who would be affected by the proposed measure, calling their attention thereto, and urging them to take immediate action through their Parlimentary representatives and otherwise, to prevent the Bill from becoming law. Other circumstances of this nature will be certain to arise from time to time in the future, and it is in this direction that the Canadian Electrical Association should be able to do valuable service on behalf of the electrical interests. In view of its probable usefulness, it should receive the support of all engaged in electrical business.

Let by your objective point on the 14th inst., be the "Ambitious City."

QUESTIONS AND ANSWERS.

A CORRESPONDENT asks: (1) What am I to understand by the terms: 6, 8 or more ampere lights? (2) What is the meaning of candle powers such as 2000 nominal? (3) Does the number of ampere lights also constitute the intensity or strength of the lights, and what is the proportion—how many amperes?—produces 2000 candle power; or how many for each ampere? (4) Would amperes produce the same strength of light with the machines of any of the leading manufacturers?

ANSWERS—(1). The number of amperes such as 6, 8, or 10, refer to the volume of current passing through the lamps. The light is about proportional to the current when the carbons are sufficiently far apart to work to the best advantage. (2). Nominal candle power is an indefinite term, the usually accepted standard being 6 ampere for a 1200 c. p.; 8 ampere for a 1500 c. p.; 10 ampere for a 2000 c. p. (3-4). A current of electricity is the same thing, no matter how, or by what company produced. When measured on an independent standard instrument a 6, 8 or 10 ampere current would produce the same strength of light no matter who built the dynamo.

W. G. B. writes: I would like some information relating to the ringing on telephone lines. In a small place, with three or four lines and necessarily a central office, do they all ring on the one magneto, and how can the central answer, without calling on all the others? I can understand how to ring to the central, but the latter part is a mystery.

ANS.—Each subscriber to a central office has a line running from his instrument to an annunciator in central office. When the subscriber rings his bell the annunciator shows who has called. The operator switches his set of instruments on to that particular line, and rings or speaks as may be necessary.

C. A. S. E. EXAMINATIONS.

The annual meeting of the Board of Examiners of the Ontario Association of Stationery Engineers, was held in Hamilton a few days ago. The President, A. M. Wickens presided. The retiring members of the Board, whose term expired this year, were re-elected, except Mr. John Galt, of Toronto, who was replaced by Mr. J. G. Campbell, of Kingston, who, with Mr. Devlin, will be the members of the Board for eastern Ontario.

The following Hamilton engineers have passed their examinations in accordance with the Ontario Act: E. Johnson, W. Stevens, A. Marshall, A. Robb and R. Chilman.

Stewart & Harper, machinery brokers, Winnipeg, have leased the electric plant at Morden,

The question of superheated steam is treated in a very original manner in *Die Natur*, a German publication, a parallel being drawn between the action of a steam boiler and the eruption of a geyser. In the latter case, according to Bunsen, a cavern filled with water 1 es deep in the earth, under the geyser, and the water in this cavern is heated by the earths internal heat far above 212°, since there is a heavy hydrostatic pressure upon it arising from the weight of water in the passage of natural stand pipe that leads from the subterranean chamber to the surface of the earth; after a certain time the temperature of the water below rises, so that steam is given off in spite of the pressure, and the column in the exit tube is gradually forced upward. The release of pressure and the disturbance of the water then cause the contents of the subterranean chamber to flash into steam and expel the contents of the exit pipe violently.

"NON-ARCING" METALS.

A discovery which promises to be of much practical importance in electrical work has been made by Mr. Alexander J. Wurts, and was described by him in a paper read March 15, before the American Institute of Electrical Engineers. In some experiments made in designing new forms of lightning arresters, a discharger was used consisting of three solid round brass rods, 1 in. in diameter and 1¼ ins. long, placed side by side with their axes parallel and air gaps of 1/16 in. between them. The line was connected to the two outside rods and the middle one was grounded. A piece of tinfoil was dropped in one of the air gaps to start the arc and a brilliant display of fireworks was expected. Instead of this a small spark no larger than a pea was the only result, and the arc was not maintained.

Mr. Wurts was inclined to ascribe this to the cooling effect of the metal dischargers upon the arc, and to test this theory determined to make much larger dischargers and also use a considerably larger current. The new dischargers were 2½ ins. diameter and 2 ins. long, and were connected to a 3,000-light, 1,000-volt alternating dynamo. When the current was turned on and the air space was bridged, the metal bars were melted like beeswax in a great ball of fire, much to the experimenter's disappointment. Thinking, however, that there could be no harm in melting up the small discharger, previously described, in the same way, he placed that in the circuit and closed the switch. To his great astonishment the small discharger remained intact, and the spark which passed was hardly larger than before.

It was then learned that the small discharger was of brass, composed of copper and zinc, while the large one, which melted so quickly, was a copper-tin bronze. Various other metals were then tested. It was found that steel, hard copper, phosphor-bronze, aluminum-bronze and aluminum, would all maintain a brilliant arc. Zinc was next tried, and with a discharger of this metal it was found exceedingly difficult to maintain an arc. This was especially surprising, for who is there at all familiar with the properties of zinc who would have suggested this metal as one likely to resist an electric arc of 1,000 volts in this manner? Tin and nickel were then tried, and the former gave the most brilliant arc of all the metals tested. Antimony was then tried, and notwithstanding its low melting point it gave no arc. The theory now advanced to explain the phenomena was that with the metals that do not allow the arc to be maintained, there is formed at the instant the arc is started, an oxide of the metal which, becoming instantly volatilized in the intense heat of the arc, chokes up the air-gap with vapors of high resistance, and presents an effective barrier to the further passage of the current. With metals that do maintain the arc, instead of the vapor of the oxide of the metal, there is formed a pure vapor of the metal itself, and this offers comparatively no resistance to the passage of the current. It will be noted that all the above tests were made with the alternating current. The direct current was next tested; and while an arc was formed with all the metals, it was very small and quiet with the zinc and the antimony.

A curious phenomenon connected with zinc and antimony is that there is less tendency to maintain the arc when the air-gap is small. Using an air-gap 2 ins. long and a 1,000-volt alternating current, the arc when once started will be maintained.. At ½ in. or ¼ in. the arc tends to maintain itself; but at 1/32 in. there is only a small spark and the circuit is instantly interrupted.

Further investigations were made to determine what other metals would act like zinc and antimony, and it was found that all available metals belonging to the same chemical group acted in the same way. Cadmium, magnesium, bismuth, and mercury in the form of a copper amalgam, were all tested with successful results,, the last named proving even better than the zinc or antimony.

The discovery has already been made use of by Mr. Wurts in the design of a special form of lightning arrester, composed of non-arcing metal. It seems likely to prove of practical importance in many forms of electrical apparatus.—*Engineering News.*

The largest power dam yet built in the United States will be that now in progress of construction across the Colorado River, at Austin, Tex. It will be, when completed, 1,150 feet long, 60 feet high, and 18 wide at the top. The up-stream face is of limestone, and is vertical, while the down stream face is of Texas granite, and the interior of rubble masonry of small stone and cement. There will be about 9,000 cubic yards of granite, 6,800 cubic yards of limestone and 55,000 cubic yards of rubble in the dam. The dam is intended to utilize the power of the Colorado River for electric lighting, electric railways, pumping the city's water, and for actories, etc.

THE ELECTRIC TRANSMISSION OF POWER.*

By Gisbert Kapp.

(Continued from May Number.)

Lecture III.

Owing to the low efficiency and small power of the two-wire revolving field motor, its employment is necessarily restricted to case where these defects are of little consequence, but for the transmission of large powers over long distance it is not suitable. For such a purpose we must have three wires, but this is not a great drawback since the cost of the line is but little increased by the necessity of splitting up the total weight of copper into three instead of into two wires. The revolving field motor has, however, the defect that it is not self-regulating. Its speed may be anything between zero and that speed which will give synchronism between the two machines accordingly as the mechanical load varies from a maximum to nothing. This defect can be overcome by combining with the armature in the motor a real magnet which will force the armature to keep step with the current, and thus insure a constant speed at varying loads. The motor will thus start with great power by virtue of the currents induced in the armature-winding by the revolving field, and having reached the synchronising speed it will keep there by virtue of the interaction between the revolving field and the revolving magnet; it will, in fact, behave just like an ordinary alternator run as a motor, with this difference, however, that the ordinary alternator, if overloaded by 50 or 100 per cent., will be thrown out of step and come to rest, whereas the combined Ferraris and synchronising motor will always be ready to recover itself after the overload has been removed.

Since the discovery of Ferraris has been made public, many engineers have turned their attention to revolving field motors, and especially to a modification of this principle, according to which three sets of coils are employed instead of two sets only. As far as I have been able to trace the history of this invention, the first to suggest the use of three coils were M. Tesla and Charles Bradley. The latter applied in the United States for a patent in 1888, which bears the number 406,450, and was granted on August 20, 1889. Next comes Wenstrom with his British patent, No. 5,423, of 1890, and at about the same time Dobrowolsky, in Berlin, had worked out a similar system. About a year ago, when I visited him at the works of the Berlin Electrical Company, he showed me such a three-wire motor in action, whilst shortly afterwards Charles Brown, of Oerlikon, took the

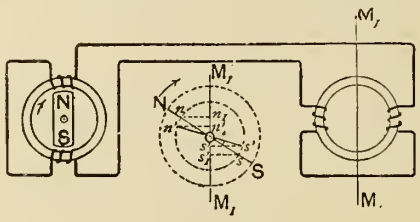


Fig. 13.

matter up, and it may interest you to learn that he is at the present moment putting up a 500 H. P. transmission plant on this system between Bülach and Oerlikon, a distance of 15 miles. This transmission is intended to supply all the power required in the Oerlikon Works. The general principle forming the base of the work done by these various inventors is illustrated in Fig. 13. The generator contains a revolving field magnet, and an armature wound with three distinct coils. The end, O, of each coil is joined to a wire, W, common to all, and the three free ends are joined with the three-line wires. At the receiving station there is a three-legged magnet, the coils on the legs being in connection with the line wires on the one side, and jointed by a common wire, W, on the other side. It is easy to see that the rotation of the field magnet in the generator will produce successive polarities in the legs of the receiving magnet, and that the general effect will be that of a revolving field. The armature, A, will, therefore, be set in rotation in the same way as is the case in the original Ferraris motor. This kind of transmission is known in Germany under the name of transmission by the "three-phase current," and it is likely that it will, ere long, become a strong rival to the ordinary alternating current.

The diagrams I have brought before you were all drawn for two-pole machines, as this was the simplest way of making the principles clear; but I need hardly say that, in practice, the machines are made of the multipolar type, in order to bring the speeds down to any desired value.

You will, perhaps, ask why we should go to the complication of three-line wires and a totally new type of motor, seeing that, with the ordinary dynamos and motors, such excellent results have been obtained, and that with two-line wires. My answer is that, with this new system, we can greatly extend the distance of transmission. I have spoken, a short time ago, of the difficulties which the high voltage required in long-distance transmission raised in connection with the commutators and general insulation of machines. Now, in the three-wire system of transmission, by alternating currents, we have no commutators, and, in fact, not even rubbing currents. One of our difficulties, has, therefore, already vanished. As to the other, which has reference to the general insulation of the machines, it is easy to see how this may be overcome. We need only, instead of working direct, work through transformers. The insulation of transformers offers no difficulty whatever. I have here on the table a transformer of the type made by Messrs. Johnson and Phillipps, which has been designed specially for high-pressure currents, and is provided with oil insulation. I have recently used two of these transformers for testing a Brook's line. In one transformer the pressure was raised from 2,400 to 17,000 volts, the high pressure current was sent through the line, and, at the other end, it was again transformed down to 2,400 volts, and, finally to 100 volts, for lighting glow lamps. The apparatus was kept running for several days without any difficulty. Mr. Brown informs me that he has with oil insulators, even gone up to 36,000 volts without breaking down the insulation, and the Bülach-Oerlikon transmission will be made at 25,000 volts, whereas the machine will work only at a few hundred volts. There is thus no difficulty in adopting whatever voltage is most economical in each case, and yet avoiding all danger, either to the attendant or to the machines themselves, at the generating and motor station.

I feel that I owe an apology for having occupied so much of your time with discussing a branch of power transmission which, to many of you, must seem to be purely theoretical, and hardly ripe for discussion. My excuse must be that I am strongly convinced that some form of alternate current working will be the ultimate solution of the problem how to transmit power—possibly over all distances, but certainly over very long distances—and that I was desirous of directing the attention of electrical engineers to a subject in which much work may still be done.

Electric Machine Tools.

In concluding my lectures, I wish to bring before you a few examples of short distance transmission as applied to electric machine tools. This branch of our subject has of late years received considerable development at the hands of various English firms, and, thanks to their enterprise and perseverance, is now a well-established method in several engineering works.

As an example, I may mention the Leven Shipyard of Messrs. Denny Brothers, at Dumbarton, and Mr. Archibald Denny has been good enough to give me some particulars of the work carried on by his firm in this direction. I cannot do better than quote his words:—"In our yard and engine works we have numerous instances of electric transmission of power. In our experimental tank we drive our model cutting machine and small lathes by means of a 3 H.P. Immisch motor. In our upholstery department we drive six sewing-machines with a 2 H.P. Immisch motor; of course in this case there is a large margin of power. In our experimental tank we have also used small motors for driving small model paddle wheels in our experimental models, and have obtained in this way most valuable data, which we could not have got by any other means. The power for all this work is obtained from a dynamo driven by an ordinary line of shafting in our joiner's shop. We also use a 3 H. P. motor in the yard for boring the stern tubes in place; before this we used a portable engine, which necessitated an attendant to fire the boiler and carry water to it. During the holidays, when all the boilers are off except one, we occasionally put down a motor for driving some lathes to do repair work, and this saves an attendant at more than one boiler. In our engine works the the pattern shop is driven by a 15 H.P. Manchester motor, the dynamo being driven off the line of shafting in the fitting shop."

You see, Messrs. Denny Brothers find electric power transmission so handy, economical, and convenient, that they make extensive use of it. They employ a special tool for drilling the

*Cantor Lectures delivered before the Society of Arts, February and March, 1891.

sole plates of engines, which I now show on the screen. The weight of the machine is sufficient for the pressure required on the drill, and the whole apparatus being mounted on wheels it can be readily shifted. The machine will drill 1¼ in. holes through two thicknesses of inch plate in three minutes.

Another machine used at Leven Shipyard is a special drill for butt straps The motor and gear are mounted on a stout vertical column with horizontal arm, so as to give adjustment in both directions, the column being bolted to the strap, as shown. The machine will take in straps 50 in. deep by 23 in. between outer rows of holes, and is chiefly used for drilling sheer strake double but straps. The outside strap is first punched and countersunk, and the machine drills through the plate and inside strap. The machine is worked by two men—one hole-borer and one laborer—and will do three straps, or about 180 holes per day.

The rivet holes in boiler furnaces are also drilled by an electric tool, which I illustrate on the screen. The machine has a tripod stand arranged to go inside the furnace, but it has also holding-on magnets for outside work. One man with this machine does the work which formerly required three to four men.

No account of electric machine tools would be complete if it did not include the work done by Mr. Rowan, who has been very successful in developing this branch of power transmission. Amongst the improvements Mr. Rowan introduced is that of holding-on magnets, whereby the tools are firmly held in place while at work, and yet by the mere turning of a switch become liberated and can be shifted to a new position with the greatest ease. You see on the screen some of Mr. Rowland's drillers as applied to ship work. The apparatus is suspended on a chain over the ship's side, and supplied with current by means of two flexible wires. I need not detain you with a description of the picture on the screen because I can show you the actual machine at work, thanks to the kindness of Messrs. M'Whirter, Fergusson and Co., the makers, who have sent me one of their latest machines for this lecture.

I am also indebted to Mr. Webb, the locomotive superintendent of the London and North-Western Railway, for the loan of one of his electric tube cutters, which you see before you, and which I shall now work. A diagram of this machine to an enlarged scale is on the wall.

These few examples of what are properly called electric machine tools must suffice for this lecture, but there is another class of apparatus, namely, electric mining machines, which ought to be included in our subject. Several firms, both here and abroad, have of late years devoted considerable attention to the application of electric power to mining operations, such as pumping, hauling, coal-cutting, and drilling. Messrs. Goolden & Co., for instance have during the last four years steadily and perseveringly worked out many of the difficult problems in connection with this subject, and I am indebted to this firm for the loan of the apparatus you see here, and also to Mr. Atkinson for assisting me in setting the machines up. After the excellent Paper which Mr. Atkinson read at the Institution of Civil Engineers, only a few weeks ago, it would be occupying your time uselessly if I were to give any lengthy description of these machines. I shall, therefore, merely show two types of mining motor on the sereen, and show a drill at work.

I have in these lectures not attempted to treat exhaustively any one branch of the subject, but have rather endeavored to pass the various branches in rapid review, so that you may know what electric transmission of power can do and what it cannot do. We hear now-a-days very frequently the assertion that electricity is but in its infancy and will ere long be the sole motive power, driving our main-line trains, speed our vessels across the ocean, and running our factories. These are idle dreams, ideas put forward by persons who have forgotten, or have never learned the fundamental laws of nature. Do not waste time over such ideas, for there are other more hopeful problems, such as the utilization of water power generally, of waste coal at the pit's mouth, the working of railways in mountainous districts, where water-power is abundant all along the line, the working of tramways, underground town railways, the application of electric power to such purposes for which now small auxiliary steam engines are employed, and last, but not least, its application to machine tools and other special machinery, of which I have given you examples to-night.

SAFTEY VALVES—THEIR HISTORY, ANTECEDENTS, INVENTION AND CALCULATION.

By William Barnet le Van.

(Coutinued from May Number.)

One form of annular valve is shown in Fig. 49, the external diameter being 4 inches; internal diameter, 3.25 inches. The steam passes outside of, and through, the valve to the atmosphere.

The valve shown in Fig. 50 has proved a very efficient safety valve. Steam is discharged at the outer edge of the valve and through apertures in

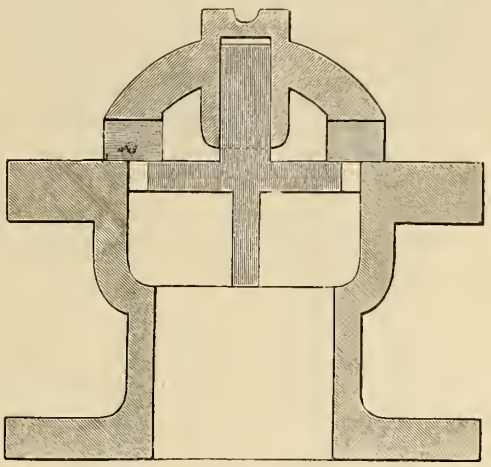


Fig. 49.—Annular Safety Valve.

the valve itself. The valve is guided to its sit by means of a central spindle extending below its sit. The principle of annular safety valves is not new.

double-sit safety valves.

These valves are constructed with two openings of unequal areas for the escape of the steam. The valves are attached to the same spindle, and the pressure, acting upon the one with the larger area, tends to force it *from* its sit; the pressure acting upon the one with the small area, tends to force it *to* its sit. The extra force applied to prevent the valve from opening is just sufficient to balance the difference between the two areas.

The inventor of this safety valve claims simplicity of arrangement of parts; that it will relieve a boiler of all excess of pressure quicker and more

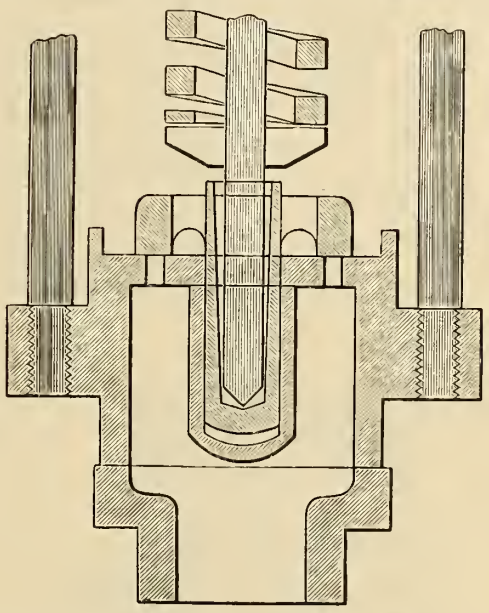


Fig. 50.—Annular Safety Valve.

freely than any other safety valve; that it will rise exactly at the pressure desired, and re-seat instantly on the pressure receding below the point at which it opens; and that it is not liable to be acted upon by rust and dirt from a boiler.

The *ratio* of the difference between the areas of the two openings is so arranged that, by the addition of one pound weight to the valve stem, one pound additional pressure per square inch will be necessary to open it.

On a test made of this valve, the claims of the inventor were not sustained. It is doubtful if *double-seated valves* will ever be made to answer the purpose intended.

Piston Safety Valves.

Piston valves are operated by the pressure of the steam acting against the end of a piston fitted to a cylinder, forcing it outwards, and uncovering gradually the opening of the valve.

The one great objection to the use of piston valves, namely, that they are likely to become clogged by the accretion of matter around them (unless in constant operation), as to prevent them operating until a large excess of pressure is attained, militates against their general use. There is no doubt that in this form of valve a much larger effective area can be obtained than with the common lever valve, and one with a smaller diameter may be employed.

The piston of the valve shown in Fig. 52 is of a larger area than that of

the valve proper, and is located some distance below the valve sit, and attached to the valve by means of a spindle extending downwards, Between the piston and the valve proper is a space which may be called a reduction chamber. The steam is admitted into this chamber through apertures in the surrounding casing just above the top of the piston, and when the pressure exceeds the resistance of the weight on the valve proper, and lifts it from its sit, it brings up with it this piston. The apertures in the casing are, by this action of the valve, partially closed by the piston, and the steam is

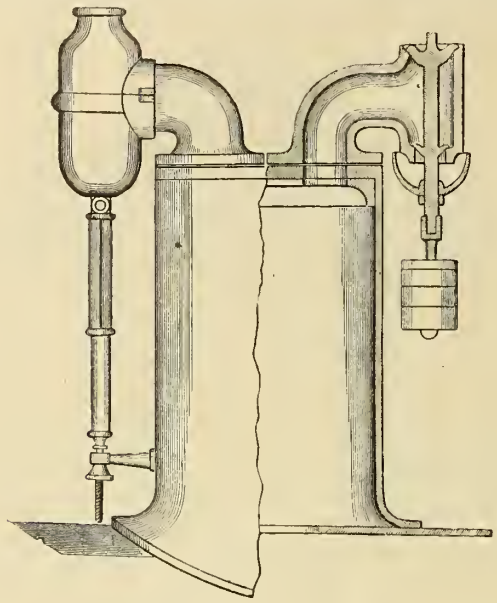


FIG. 51—DOUBLE-SIT SAFETY VALVE.

gradually being cut off, thereby reducing the pressure in the reduction chamber, and upon the upper side of the piston. This reduced resistance to the rising of the piston, and the area exposed to the pressure of the steam in the boiler being somewhat in excess of that of the valve proper, it forces the valve further from its seat, where it will remain until the pressure in the boiler is sufficiently reduced to allow the piston to fall below the apertures above mentioned, when the valve proper will suddenly seat itself.

COMBINATION SAFETY VALVES.

The great objection to combination safety valves is that they are too complicated. The object in this form of valve is to obtain an effective area equal to that due to the diameter of the opening of the valve—a worthy effort. The writer entertains hope that inventors will not despair of success, but will continue their efforts to reach such a result.

In Fig. 53, it will be seen that from the end of the lever, extending downwards, is a bar which connects with the short end of a toggle, or bell-crank lever, to the long end of which the spring-balance is attached, and in the

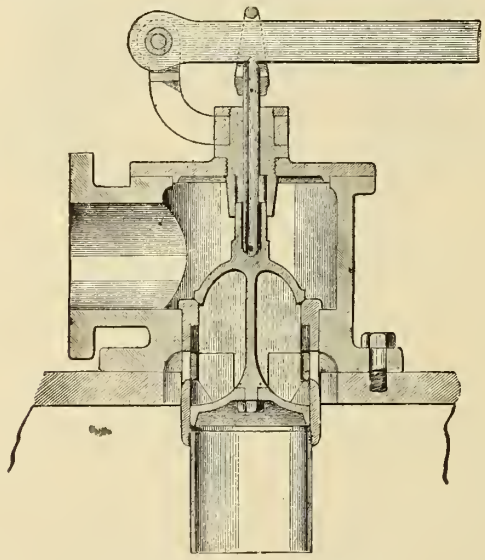


FIG. 52—PISTON SAFETY VALVE.

position to act upon the main lever through the connecting-bar above mentioned whenever the pressure in the boiler overcomes the resistance of the spring-balance, and assists in raising the valve from its sit. The object of this arrangement is to get an increase of lift to the valve.

DUAL SAFETY VALVES.

By the city ordinance for the inspection of boilers in the city of Philadelphia, in accordance with Acts of Assembly approved May 7th, 1864, also ordinance of Councils, appoved July 13th, 1868, all steam boilers are required to have on each boiler, when fired separately, two or more safety valves. When a given safety valve area is distributed over two or more valves, the efficiency for the relief of steam is greater than when the area is contained in one valve, because the circumference of the valve of a safety valve is the measure of the amount of orifice that is presented for the outflow of the steam; for example, an area of 20.62 inches is required, and we find that two valves, each 3⅝ inches in diameter, equal the above, and their circumference amounts to 22.76 inches; but if we have only one valve, its diameter would be 5⅛ inches, and its circumference 16.10 inches. This comparison shows the advantage and wisdom due to two safety valves in point

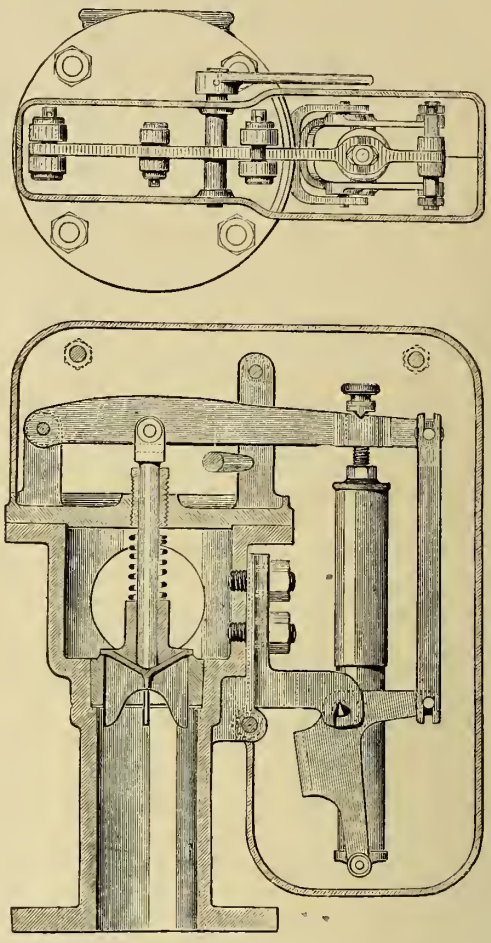


FIG. 53—SPRING AND LEVER LOADED BELL-CRANK COMBINATION SAFETY VALVE.

of safety, regardless of its advantage of less risk of both valves being out of order at the same time.

RAMSBOTTOM'S SAFETY VALVES.

Ramsbottom's arrangement consists of two safety valves held down by a single stout helical spring, placed midway between them. The spring holds down both valves with equal force, and the cross-bar to which the spring is attached, and which rests upon both valves, is prolonged at one end, so as to afford a handle by which the engineer may occasionally try his steam. Any movement of this handle by the engineer, whether up or down, frees one valve by pressing down the other; and it is thus impossible, by holding down or fastening down this handle to prevent the escape of steam, and thus increase the pressure; for to force down, or to force up, the handle would only let off steam. This feature the writer believes is one of the best yet introduced for safety valves. When the pressure rises too high, both valves blow off alike, and both rise to the full extent to which the spring is extended, instead of, as in the ordinary arrangement, to but one-eighth, or perhaps

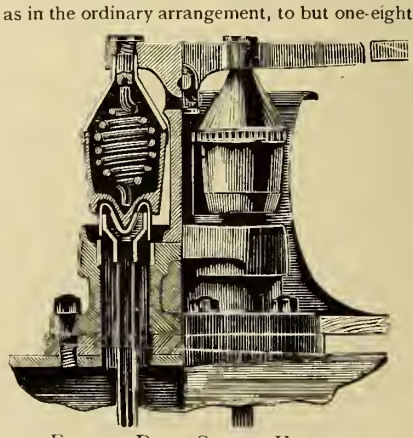


FIG. 54—DUAL SAFETY VALVES.

one-twelfth of the extension of the spring. Even with a strong fire, the steam cannot rise but a very few pounds above the pressure at which the valves are set to blow off.

In this safety valve the pressure can be removed from either valve at pleasure, by merely raising or depressing the free end of the lever, while at the same time the arrangement prevents over loading.

(To be Continued.)

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TRADE NOTES.

Mr. George Keating of Kemptville, Ont., has recently installed a 350 light alternating electric plant, which was manufactured for him by the Royal Electric Company of Montreal.

La Seminaire de St. Hyacinthe have closed with Miller Bros. & Toms of Montreal for a complete laundry outfit, and the shafting hangers and Hill friction pulleys required for their electric light plant.

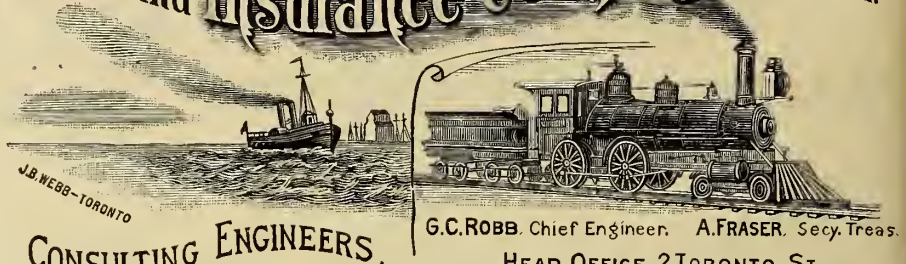
Messrs. J. M. Fortier & Co., cigar manufacturers, and Fred. Carstens, of Montreal, have equipped their factories with motors, which were manufactured and supplied to them by the Royal Electric Company of Montreal.

The Royal Electric Company have recently closed a contract with the Zoological Gardens at Montreal for a 50 light arc dynamo and a 400 light incandescent machine, a 40 horse power generator and a complete equipment of 16 trolley cars to run the new system of electrical race-course. This will be the first of its kind in use in the Dominion of Canada and the design was made lately in Paris by some very eminent electricians.

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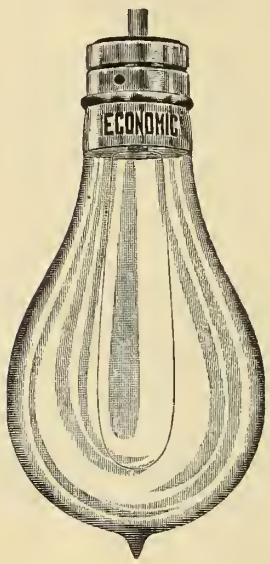
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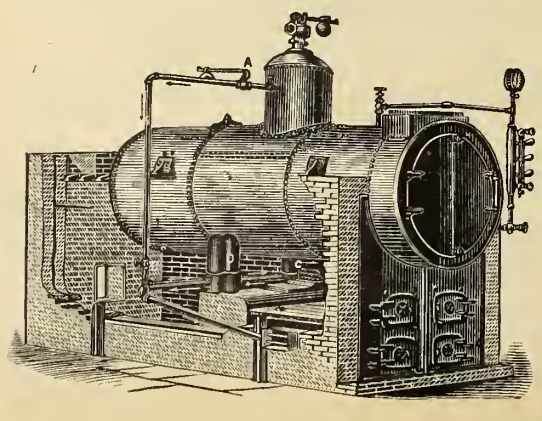
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TRADE NOTES.

The Royal Electric Company are installing a motor for the Franciscan Monks at their new monasteries in Montreal.

Messrs. Wm. McKee and James Fyfe of Montreal, have each installed a 2½ H. P. motor manufactured by the Royal Electric Co.

The Royal Electric Co have sold to H. H. Merkley, of Morrisburg, Ont., a 650 alternating machine, with lamps, wires, &c., for a complete central station.

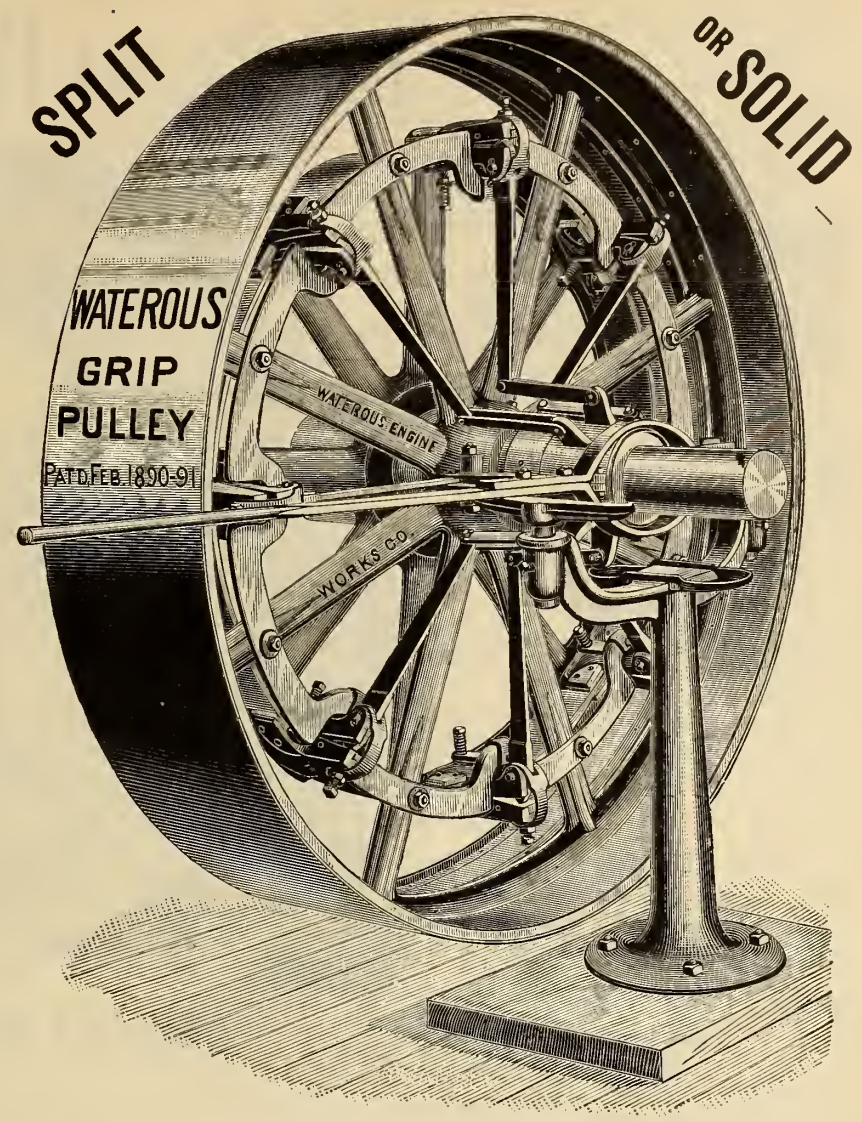
Mr. T. W. Ness, of Montreal, dealer in electrical supplies, has recently removed from 644 Craig street to larger premises at No. 749 on the same street.

Messrs. T. Eaton & Co., Toronto, have added a 50 light arc dynamo with necessary wires, lamps, &c., to their plant. The purchase was made from the Royal Electric Co. Messrs. Eaton & Co. now have one of the largest isolated stations in Canada, with a capacity of 125 arc and 400 incandescent lamps.

The Royal Electric Company has recently installed electric light plants in Huntsville and Bracebridge. Each of these plants are of a total capacity of 500 lights and the parties for whom they have installed the plants have met with unprecedented success in canvassing for lights and expect to double the size of these plants during the coming year.

The Royal Electric Company last week shipped two car loads of electrical machinery to Messrs. Stuart and Harper of Winnipeg, Man., the plant consisting of a 50 light arc dynamo of their Thomson Houston manufacture, 2000 c. p., 60 arc lamps and a 1500 light alternating dynamo complete with the necessary transformers, wire and other equipments.

The Ball Electric Light Co., Limited, of Toronto, report recent sales to the Wiarton Electric Light Co., one 50 light 4 ampere dynamo (this is an increase order, making total capacity of Wiarton plant, 100 arc lamps or equivalent in series incandescent lamps, of which large numbers are in use.) Also Knechtel Furniture Co., Hanover, 105 light automatic incandescent dynamo and lamps; Toronto Engraving Co., one electric motor, etc. The Ball Co.'s new key socket for series incandescent lamps is having a large scale, as it fits both Heisler and Bernstein lamps and its circuit closing devise is simple and positive without requiring renewals. Porcelain fittings are used in this socket.



300 H. P. GRIP PULLEY, FROM PHOTOGRAPH OF PULLEY FURNISHED ROYAL ELECTRIC CO., MONTREAL.

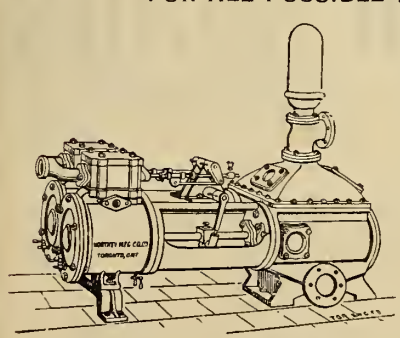
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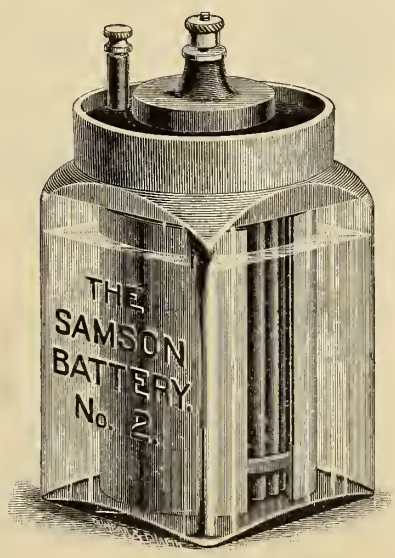
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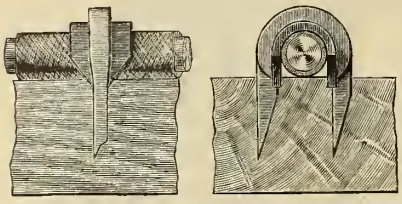
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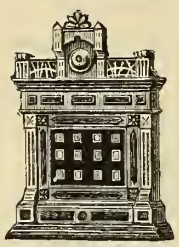
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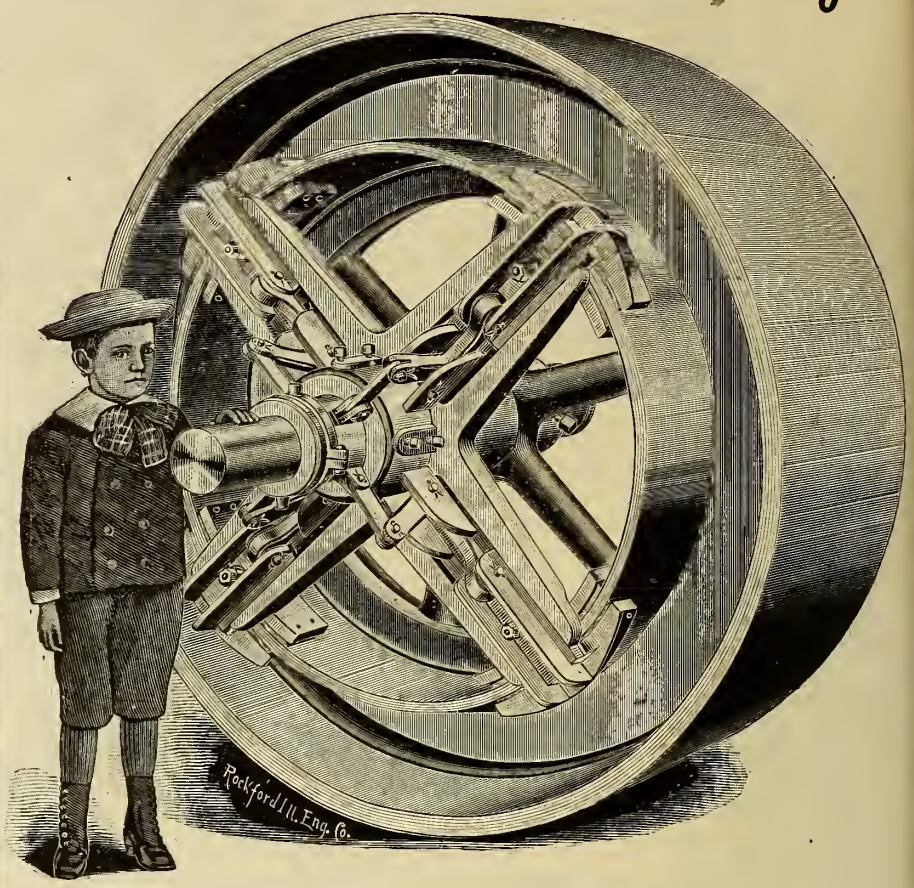
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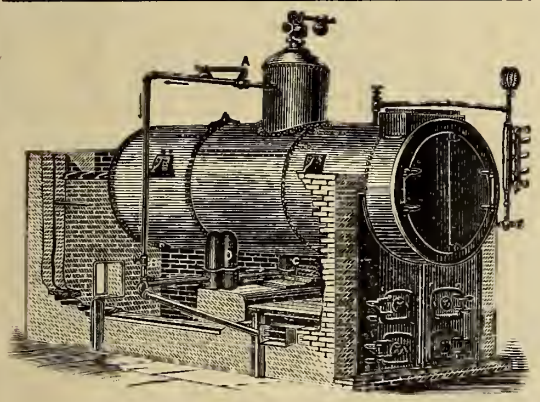
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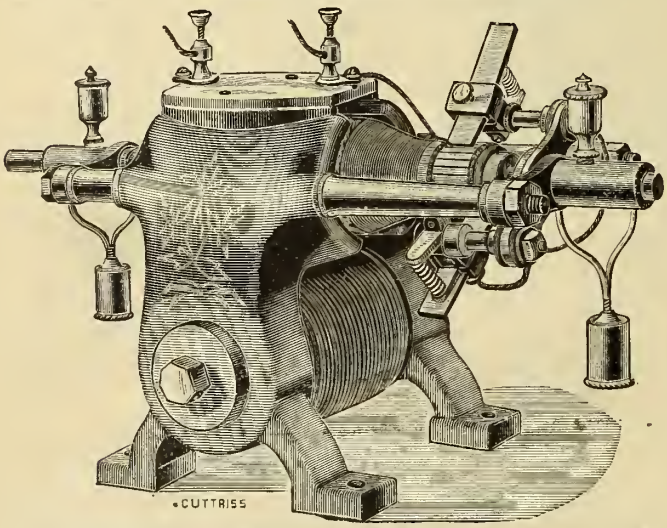
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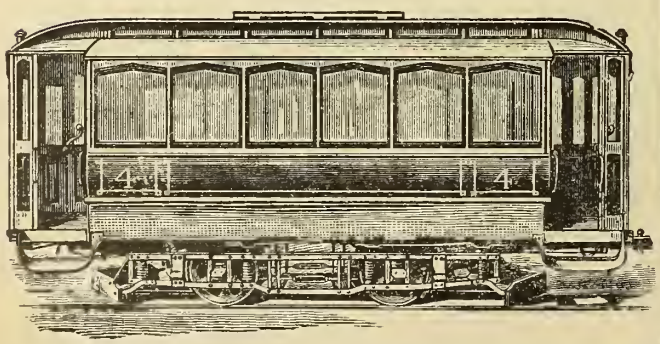
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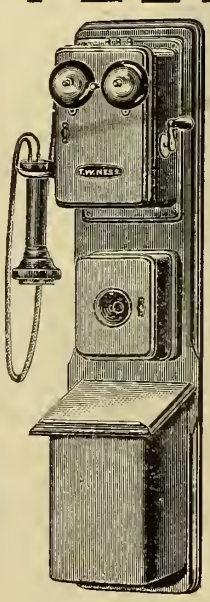


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CANADIAN

ELECTRICAL NEWS

AND

STEAM ENGINEERING JOURNAL.

VOL. II. TORONTO AND MONTREAL, CANADA, JULY, 1892. No. 7.

CANADIAN ELECTRICAL ASSOCIATION.

PROCEEDINGS OF THE FIRST ANNUAL CONVENTION.

THE first Convention of the Canadian Electrical Association met in the Board of Trade rooms in the city of Hamilton, on Tuesday, June 14th, 1892, at 2.30 o'clock The Executive Committee held a meeting at 11 o'clock, arranged for the appointment of a Committee to nominate officers for the ensuing year, and elected the following new members:

Active—T. W. Whiting, Local Manager Bell Telephone Co., Guelph; J. V. Hedenburg, Edison Gen. Elec. Co., Hamilton; A. R. Baker, Local Manager, Bell Telephone Co., St. Thomas; Hugh C. Baker, B. T. Co., Hamilton; R. B. McMicking, Mgr. Esquimault and Victoria Telephone Co., Victoria, B. C.; J. M. Campbell, Bell Telephone Co., Kingston; H. P. Dwight, Pres. G. N. W. Telegraph Co., Toronto; H. S. Thornberry, Toronto Electrical Works; Henry A. Everett, Toronto Street Railway Co., Toronto; F. C. Armstrong, Toronto Construction and Electrical Supply Co., Toronto; J. Norman Smith, Ball E. L. Co., Toronto; W. A. Tower, Bell Telephone Co., Toronto; P. A. Dickinson, E.L.Co., Brantford; Lewis Burran, Royal Electric Co., Montreal; T. R. Rosebrugh, Toronto; Hunt Bros., London; E. T. Freeman, Edison Lamp Works, Hamilton; S. Douglas, Manager Kay Electric Works, Hamilton; T. L. Kay, Electrician, Kay Electric Works, Hamilton; H. H. Henshaw, Royal Electric Co., Montreal; C. C. L. Wilson, Ingersoll; R. Æ. Kennedy, President Ham. Elec. L. & P. Co., Hamilton; Mr. Stillwell, Edison Lamp Works, Hamilton; J. V. Teetzel, Vice-Pres. Ham. Elec. L. & P. Co., Hamilton; T. Ahearn, Ottawa; D. Y. Soper, Ottawa; A. M. Wickens, Electrician, *Globe*, Toronto; H. G. Hunt, St. Catharines; James Stuart, Manitoba Elec. & Gas Lt. Co., Winnipeg; T. W. Ness, Montreal; Robert Bell, Dunnville Elec. Lt. Co., Dunnville; J. H. Eckert, Brantford.

Associate—J. S. Knapman, Peterboro'; W. C. Scott, Napanee; A. Knowles, Bell Telephone Co., Toronto; Edward B. Merrill, Toronto; C. A. Martin, Montreal; S. J. Stratton, Hamilton; W. G. E. Boyd, Hamilton Electric Light and Power Co., Hamilton; H. W. Kent, New Westminster & Burrard Inlet Telephone Co., Vancouver, B. C.

At 2.30 o'clock, the President of the Association, Mr. J. J. Wright, took the chair, and opened the convention with the following remarks:

Gentlemen,—Although this is the first Convention of the Canadian Electrical Association and our organization is not yet a year in existence, we number one hundred members. This membership includes representatives of every branch of electrical industry. The object of the Association is to conserve the interests of the industry, both from a commercial and scientific standpoint. Electricity is rapidly becoming one of the chief agents in human civilization, and consequently an Association of those engaged in the development and application of its varied uses must necessarily be one of importance and power, and will take its place in the vanguard in the march of modern progress.

The formation of the Canadian Electrical Association has been more than justified by recent events, and the wisdom of rubbing off little asperities of rivalry and banding together for mutual protection, will become more and more evident as time passes.

It cannot be said that the large amount of capital invested in electrical enterprises has received the return that the investors have had a right to expect. The protection of this capital, therefore, should be one of the chief aims of the organization. Our associate members are as much interested in this as the largest capitalist in our ranks, for the permanence and solidity of electrical investment must be the basis on which they will have to depend for their future prospects in life.

It is probable that we shall have some information brought before us, at a later period of the proceedings, bearing upon the financial aspects of electrical business, and it is to be hoped that some suggestions will also be forthcoming as to the best means of improving the condition of electrical investments.

No records are sufficiently ample and complete to give a definite and correct indication of the multitude of undertakings employing electricity in its varied forms, and it will be the duty of this Convention to appoint a special committee to complete statistical information for the use of its members—in the branch of electric lighting, for instance, the number of lights in use in the various cities and towns of the Dominion, the prices obtained for them under the diverse conditions of their operation. Special endeavor should also be made to obtain information of the actual cost of operation and condition of lighting plants operated by municipalities themselves.

I would also like to foreshadow some action by this body in regard to a standard to be adopted and fixed, for describing and producing arc lights of various nominal candle power. The Dominion Government are thinking about a move in this direction, but it will rest with an assembly of electrical talent, such as have now met together, to determine on an arbitrary unit which should be recognized and referred to as the unit of the Canadian Electrical Association.

In view also of proposed legislation affecting electrical interests, it would be well for this Convention to consider the advisability of appointing a permanent committee, whose duty it would be, to keep in touch with matters of this kind, and report from time to time to the Executive, as may be necessary.

I am anxious to see this Association, coming into existence under such promising conditions, become a power in the land. Combining as it does, the varied branches of electrical work, being a society where light and power men, telegraph and telephone experts, manufacturers of electrical machinery, and engineers in every line of electrical development, can meet in friendly intercourse on one common plane, it should become something more than an ornamental name. It should attain to sufficient influence to be referred to as an arbitrator, whose decisions should be respected as final and weighty, and its annual gathering looked forward to as the important event of the year.

The first Convention of the Canadian Electrical Association is now open for the transaction of business. (Applause).

The following members were present:

W. A. Johnson, Manager Ball Electric Light Co., - - Toronto.
J. A. Kammerer, Royal Electric Co., - - - "
W. J. Morrison, Electric Light & Power Co., Cobourg, - - "
Albert E. Edkins, Boiler Inspection & Insurance Co., - "
F. E. Handy, Ball Electric Light Co., - - - - "
K. J. Dunstan, Bell Telephone Co., - - - "
Wm. Rutherford, Toronto Construction & Electrical Supply Co., "
F. C. Armstrong, Toronto Construction & Electrical Supply Co., "
W. J. Clarke, Bell Telephone Co., - - - - "
J. J. Wright, Toronto Electric Light Co., - - - "
Jas. A. Baylis, Bell Telephone Co., - - - - "
W. A. Tower, Bell Telephone Co., - - - "
Hugh Neilson, Bell Telephone Co., - - - - "
John A. Doucett, Bell Telephone Co., - - - "
W. J. Duckworth, G. N. W. Telegraph Co., - - - "
H. Beaumont - - - - - - "
A. Knowles, Bell Telephone Co., - - - - "
Hy. S. Thornberry, Toronto Electrical Works, - - "
A. B. Smith, G. N. W. Telegraph Co., - - - "
George C. Stannard, Toronto Construction & Elec. Supply Co., "
W. Bourne, Toronto Electric Light Co., - - - "
Prof. Rosebrugh, School of Practical Science, - - "
J. Norman Smith, Supt. Ball Electric Light Co., - - "
Frederic Nicholls, manager Tor. Construction & Elec. Supply Co., "
C. H. Mortimer, ELECTRICAL NEWS, - - - "
John Galt, C.E., - - - - - - "
D. A. Starr, Royal Electric Co., - - - - Montreal.
Geo. W. Sadler, Robin & Sadler, - - - - "
L. Burran, Royal Electric Co., - - - - "
John Carroll, Eugene Phillips Electrical Works, - - "
Geo. Black, G. N. W. Telegraph Co., - - - "
R. T. Dickinson, Electric Light & Power Co., - - "
G. J. Stratton, Bell Telephone Co., - - - "
Thos. H. Wadland, Supt. Construction Bell Telephone Co. "
W. J. Jones, Bell Telephone Co., - - - "
B. J. Throop, Bell Telephone Co., - - - "
J. C. McLachlan, Bell Telephone Co., - - "
Thos. J. Kay, Kay Electric Co., - - - "
D. Thomson, Electric Light & Power Co., - - "
S. Douglas, Kay Electric Works, - - - "
R. W. Gardiner, Electric Light & Power Co., - - "
Sam. E. Gardiner, Electric Light & Power Co., - - "
R. Æ. Kennedy, President Electric Light & Power Co., - "

H. O. Fisk, Peterboro' Light & Power Co., - - Peterboro'.
T. H. Brooks, Brooks Mfg. Co., - - - - "
J. S. Knapman, Bell Telephone Co., - - - "
J. W. Taylor, manager Brooks Mfg. Co., - - - "
A. Stevenson, manager Electric Light & Power Co., - "
John Yule, Guelph Gas & Electric Light Co., - - - Guelph.
T. W. Whiting, Bell Telephone Co., - - - "
A. T. Smith, Bell Telephone Co., - - - Kingston.
J. M. Campbell, Kingston Light, Heat & Power Co., - "
P. A. Dickinson, Brantford Electric Light Co., - Brantford.
J. W. Eckart, Bell Telephone Co., - - - "
John J. A. Hunt, Forest City Electric Light & Power Co., - London.
S. J. T. Brown, Bell Telephone Co., - - - "
W. G. Fraser, Bell Telephone Co., - - - Petrolea.
F. G. Proutt, Bowmanville Electric Light Co., - Bowmanville.
A. R. Baker, Bell Telephone Co., - - - St. Thomas.
Robert Bell, Dunnville Electric Light Co., - - Dunnville.
H. H. Powell, Woodstock Electric Light & Power Co., - Woodstock.
C. J. Leslie, Bell Telephone Co., - - St. Catharines.
W. R. McLaughlin, *Electrical World*, - - New York.
E. S. Edmonson, Electric Light Co., - - - Oshawa.

The President: Mayor Blaicher of Hamilton will now address the Convention.

Mayor Blaicher: Mr. President and Gentlemen of the Canadian Electrical Association,—I am glad to appear here on behalf of the Corporation of the city of Hamilton, to extend to you as hearty a welcome as it is within our power to give. We feel highly complimented that such a body of scientific men should select this City as the place for their deliberations. In speaking with some of the aldermen to-day, I was informed that those present have already discovered the principle of controlling the power of electricity. I have no doubt that is so, and considerable might be said on this and other points which I do not consider myself technical enough to undertake; but let me say that my principal business here is to extend to you as hearty a welcome as we know how, and to say that our Public Buildings are open to you during your stay with us; we shall be glad if you will make full use of the City Hall, Public Library, etc. Any assistance you may require in any way, just make known to Mr. C. R. Smith, Secratary of our Board of Trade, and we will try to do all in our power to satisfy your wants. You have our most hearty wishes that you may develop into one of the best associations that we have in the Dominion of Canada. (Applause).

After the Secretary had called the roll, the following resolution was passed:

W. J. Morrison moved, Mr. Stannard seconded, that this association place on record their regret at the demise of Mr. W. C. Palmer, of Toronto, who had been actively connected with the Canadian Electrical Association, and that a letter conveying the same be sent to the bereaved family.

President: We will now hear from the Secretary-Treasurer, Mr. C. H. Mortimer, his Annual Report.

SECRETARY-TREASURER'S ANNUAL REPORT.

In presenting this, my first annual report, it seems to me that I should outline briefly the initiatory steps taken toward the organization of this Association. In the latter part of 1890 or the early part of 1891, Mr. S. J. Parker, of Owen Sound, who is now a member of the Executive Committee of the Association, issued a circular to the electrical companies throughout Ontario, requesting to be furnished with certain statistical information relating to the electric lighting business. At the same time, in personal interviews, Mr. Parker suggested the advisability of forming an organization in the interests of those engaged in the electrical business in Canada. These facts having come to the knowledge of the Secretary of the present Association, he began to advocate through the ELECTRICAL NEWS the immediate carrying out of Mr. Parker's idea, and acting in conjunction with Messrs. Wright, Yule and others, circulars were issued inviting all persons interested to attend a meeting in Toronto during the last week of the Industrial Exhibition of 1891, to consider the advisability of forming an Association. Pursuant to this invitation, a meeting was held in the offices of the Industrial Exhibition Association, on the 17th of September, 1891, at which there were present 21 persons, representing the various electrical interests. Mr. J. J. Wright was called upon to preside, C. H. Mortimer acting as Secretary. Several letters were read from persons unable to attend, expressive of their sympathy with the movement. A Committee was appointed to formulate a scheme of organization, and report to a meeting to be held on the 26th of November following.

On the 28th of September, this committee met, arranged a basis of organization and instructed the Secretary to issue circulars to persons throughout the Dominion who might be supposed to be interested in electricity, explaining what was proposed to be done and inviting their co-operation. On November 26th, as per adjournment, a meeting of those interested was held in Toronto. The same number of persons were present as at the former meeting, though the *personnel* of the meeting was somewhat changed. Mr. J. J. Wright was again asked to preside. Communications were read from persons unable to attend the meeting, but desirous of seeing an Association formed. It was decided after some discussion to organize under the name of the "Canadian Electrical Association," after which the officers elect were appointed, a form of Constitution and By-laws adopted, and the place and date of the first annual meeting fixed.

The first meeting of the Executive Committee was held in Toronto, on the 10th of February, at which meeting 12 members were elected. Names of persons who should be asked to prepare papers for the annual meeting were suggested, and subjects allotted to each. Sub-committees were appointed to arrange for a place in which to hold the Annual meeting, to provide accommodation for exhibitors, to interview the railway authorities regarding special rates, to prepare a circular for distribution setting forth the objects of the Association, and to formulate a programme for the Convention.

On the 16th March, the Executive Committee held its second meeting, in Toronto. The Secretary was instructed to write to the manufacturers of electrical apparatus in Canada, asking to be advised if it was their intention to make exhibits at the Convention. 17 new members were elected. The date of the annual meeting was definitely fixed. The third meeting of the Executive Committee was held at Hamilton, on May 10th. In view of the fact that many of the manufacturers of electrical apparatus had intimated their inability to make an exhibit this year, it was decided to take no further steps toward holding an Exhibition. It was ordered that circulars be issued, giving full particulars concerning the Convention, a programme for which was also outlined. The Hamilton members of the Association were appointed a Committee on "Invitations." The Toronto members were instructed to prepare a programme, certificates of membership, badges, etc. 26 new members were elected.

The growth of the Association thus far has been very satisfactory. It is a somewhat surprising, yet gratifying fact, that although located in a much smaller field, it has up to the present made greater progress than the National Electric Light Association of the United States, at a similar period in its history. At the meeting of the National Association, in Montreal last year, the total membership was shown to be 220, or less than two-thirds greater than that of this Association, the existence of which covers only a period of 7 months. On May 31st, the close of the Association year, the membership roll included the names of 55 active members. The various provinces are represented as follows:—Ontario 59; Quebec 9; Nova Scotia 2; British Columbia 3; Manitoba and North-West Territories 7; New Brunswick 0; Prince Edward sland 0. There is also one member representing the United States. There have been elected since the date of this report 27 active members and 7 associate members, bringing the present membership of the Association up to 109. The following statement will show the financial position of the Association on the above date:

Receipts.

48 Active member's fees, $5.00 each	$245 00
24 Associate members fees, $2.00 each	48 00
From Guelph Gas Company, advanced before organization	10 00
	$303 00

Expenditures.

Refund to Guelph Gas Company, amount advanced before organization	$ 10 00
Refund Associate membership fee of W. C. Palmer, deceased	2 00
Allowance to C. H. Mortimer for sundry items of expense paid by him prior to organization, for postage, stationery, printing, etc	10 00
Hall rent for first meeting	2 00
Blank-book, cash-book, minutes and receipts	2 25
Exchange on cheque	15
Post-cards and postage stamps from date of organization to May 31st, 1892	24 25
Stationery and printing	32 11
Cash in Merchants' Bank	199 99
Cash in hands of Treasurer	20 25
	$303 00

There are yet 9 active membership fees remaining unpaid, which will bring the total receipts for the past year up to $348.00

Although it was understood that the members of the Executive Committee would be recouped for personal expenses in connection with attendance at meetings of the Executive, they have very generously declined to accept anything for this purpose from the funds of the Association, until such time as the organization may be considered to have reached a satisfactory financial position. I may be permitted to call attention to the fact that as the membership fees already paid in are intended to cover the present Association year, ending 31st May, 1893, the Association must depend for the financial requirements of the present year, solely upon the balance in hand, the unpaid membership fees and the fees of new members who may come into the Association during the year. Therefore there is need for personal effort to extend the membership, and for careful husbanding of resources.

Mr. Dunstan: That report reveals how greatly we are indebted to Mr. Mortimer, and in moving the adoption of it, I might say that we cannot help feeling very much encouraged with the satisfactory statement our Secretary and Treasurer has presented to us.

This motion was seconded by Mr. Carroll and the report unanimously adopted.

The President read the regrets of Mr. S. J. Parker, of Owen Sound, who was to have taken part in the Convention, but owing to important business engagements was not able to attend. He sent the statistics which he purposed laying before the meeting.

The President announced that he had been in communication with the officials of the Industrial Exhibition Association, of Toronto, who were anxious to have an electrical exhibition in connection with the Exposition. He had been distinctly authorized to state before the Convention that the Industrial Exhibition Association would be glad to meet the Association, and would be willing to do anything possible to provide all the facilities necessary for a first-class exhibit.

Letters were read from Hugh C. Baker, of the Bell Telephone Co., and H. P. Dwight, President of the G. N. W. Telegraph Co., enclosing with their applications for membership cheques for $25 as donations towards the expenses of the Association.

The President: We will now hear from the Committee on Nominations, and I might just say in explanation that this Committee was named by the Executive this morning to make nominations for the ensuing year. The nominations will not be limited to the names mentioned in the report.

A. B. Smith—After looking at our Association interests from every standpoint, and thoroughly considering the most suitable men for our offices and the Executive Committee, we submit the following for your consideration. You will notice that while we would recommend that 9 members comprise the Executive Committee, we have submitted 11 names, so that it remains with you to choose 9 out of the number.

Messrs. K. J. Dunstan and J. Carroll were appointed scrutineers, and declared the following officers elected for the ensuing year:

President—J. J. Wright, Toronto; First Vice-President—K. J. Dunstan, Toronto; Second Vice-President—John Carroll, Montreal; Secretary-Treasurer—C. H. Mortimer, Toronto, all re-elected; Executive Committee—Messrs. D. A. Starr, Montreal; H. O. Fisk, Peterboro'; W. A. Johnson, Toronto; S. J.

Parker, Owen Sound ; A. B. Smith, Toronto ; Thos. H. Wadland, Hamilton ; D. Thomson, Hamilton ; L. B. McFarlane, Montreal ; John Yule, Guelph.

Mr. Morrison, seconded by Mr. Edkins, moved that a Committee be appointed to revise the constitution and by-laws of the Association, and to report at the to-morrow afternoon session. Carried.

The following were named to constitute the Committee: Messrs. K. J. Dunstan, J. A. Kammerer and A. E. Edkins.

Mr. Yule: I would move that a Committee on Statistics be appointed, consisting of Messrs. D. Thomson, A. B. Smith and C. H. Mortimer. The motion was seconded by Mr. Wadland, and carried.

On motion of Mr. Edmondson, seconded by Mr. Johnson, the name of J. Yule, of Guelph, the mover of the resolution, was added to the Committee.

A Committee on Legislation was also appointed, composed of Senator Thibaudeau, of Montreal, and J. E. B. Powell, of Ottawa.

Mr. Smith moved, seconded by Mr. Thomson, that the ballots used in the election of the Executive Committee be destroyed. Carried.

The business of the day being over, the Chairman declared the meeting adjourned.

In the evening the delegates visited by invitation the power house of the Hamilton Electric Light and Power Company, and were shown through the new building by the manager, Mr. D. Thomson. All the visitors agreed that for solidity, convenience and the perfection of its machinery this is a model station. The visitors were regaled with cigars and light refreshments, and were made to feel that they had spent a thoroughly enjoyable and profitable time.

SECOND DAY.

The morning session was called to order at 10:30.

The President read letters from Mr. A. A. Wright, of Renfrew, and Mr. W. J. Johnson, of the *Electrical World*, regretting their inability to attend the Convention. The latter sent a substitute in the person of Mr. McLaughlin. A letter was also read from Mr. C. E. Harris, of the Bell Telephone Co., Halifax, Nova Scotia, who had purposed being present but had been prevented.

The Chairman: The first new business we should take up before we proceed with the carrying out of our program, should be to decide upon the time and place of holding our next Convention, and whether it will be advisable to meet annually or semi-annually.

Mr. Whiting: In view of the absence of some of the members of the Executive Committee, it would be advisable to leave the decision of those questions until a later hour. I move that this matter be postponed until 3 o'clock.

Mr. Thomson: I will second that motion. Carried.

The Chairman: As per program, there is an excursion to Hamilton Beach, band concert and luncheon prepared for this evening's entertainment, and Mr. Thomson wishes me to announce that the delegates will get their tickets from him before leaving. Extra tickets can be had at $1 each. The train will leave the King street depot at 8 o'clock. Regarding the railway certificates of the delegates: I will be glad if the delegates will hand in their certificates to the Secretary. You understand, of course, that in order to make arrangements with the railway officials, it was necessary to guarantee so many passengers, and unless the delegates report to the Secretary we will be unable to carry out this plan. It seems to me that a number of the members of the Association have come along to the Convention without making application for this delegate's certificate.

Mr. Johnson: I move that we request the members of the Association to register their names in the Secretary's register, so that he may have the names to show the railway company if necessary. Seconded by Mr. Taylor. Carried.

The Chairman: I have pleasure in introducing to the Convention Mr. Neilson, who will read a paper on "Long Distance Telephony," which I am sure will be listened to with great interest by all present. (Applause.)

LONG DISTANCE TELEPHONY.

The subject of long distance telephony is of such magnitude that the only difficulty in putting the matter before you, is not that I may say too little, but that I may tire you by writing too much. I intend treating the subject from a popular point of view rather than a scientific one. The large number of members who are not connected with the telephone business will, I have no doubt, appreciate this. I also think the subject, in Canada at least, must in the future always be considered from a commercial standpoint. There is no doubt as to the possibility of building lines that would work say from Quebec to Sarnia, but that wires of that length, or even much shorter, would pay, is open to argument. In Canada our merchants and others do not seem to have the money to spare, or perhaps do not transact a large enough business, to justify them in paying rates that in the United States are paid as a matter of course. I need only mention in connection with this, that while a Buffalo merchant pays $4 for a five minutes conversation to New York, or $5 for the same to Boston, it is extremely doubtful if a Montreal or Toronto merchant would pay $3, or even $2, for a similar conversation between these points.

When early in 1877 it was announced that a line was being worked by telephones between a residence in the suburbs of Boston and a factory in the same city, it is doubtful if any person imagined that in less than a dozen years, commercial and social conversations would be carried on daily between points up to seven hundred miles apart. Even the inventor, Professor Bell, is not likely to have considered such work probable. It is a fact however, that, taking New York as a centre, metallic circuit lines now run to Boston, Philadelphia, Baltimore, Washington, Buffalo, Pittsburg, Cleveland and intervening cities, and in Canada similar lines have been built in the province of Quebec, from the ancient city to Montreal and the capital, also from Montreal to Sherbrooke, St. Johns, &c., and in Ontario, from Peterborough via Port Hope, to Toronto, Hamilton, London, and places between. Other lines of the same description are now being constructed or are under consideration. On all of these lines conversation is easily carried on: so easily indeed, that even at the longest distances, voices are recognized, and communications calling for the use of figures and difficult words and sentences, are transmitted as perfectly as if the speakers were in the same room. In Canada these lines have been built by the Bell Telephone Company, and in the United States by the American Telephone and Telegraph Company of New York working in connection with the American Bell Telephone Company of Boston and the different local companies in the territory through which the wires pass.

The subject of my paper naturally divides itself into three heads: the lines, the equipment, and the rates.

LINES.

When wires were first erected for the purpose of communicating by telephone, between points at a distance, it was quite natural that as many of the officers connected with the business had formerly been telegraphers, the construction should be the same as they had been in the habit of using, and accordingly No. 9—and in some places No. 12—iron wire was used, strung on poles of the usual length—25 or 30 feet—and on ordinary glass insulators, or sometimes without insulators, the reason for the latter being that it was supposed that where two or more wires were strung, the leakage to the ground would prevent a certain amount of cross talk. It is needless to say this expectation was not realized, and that first-class insulation is now considered as essential as on telegraph lines. Many miles of such lines were erected in the States before 1885. In the Dominion, the Bell Telephone Company of Canada was early in the field, and in October 1881, a line of No. 12 iron wire was put up between Hamilton and Toronto. It was soon seen, however, that iron wires,—even of a good size,—were not satisfactory over distances of a hundred miles, and even with copper, induction was very apparent, and made conversation difficult when more than that distance was attempted. It was then seen that only by metallic circuits and the use of copper wire was it possible to do thoroughly first-class and satisfactory work over long distances.

In 1885 the American Telephone and Telegraph Company constructed a line between New York and Philadelphia, carrying twenty-six wires, or thirteen metallic circuits. As soon as an attempt was made to use these lines it became apparent that the difficulty of working, on account of induction between the metallic circuits, was as great as with single wires. A large number of experiments showed that only by a most complete system of transposition, so that every metallic circuit should maintain the same relative exposure to every other circuit, was it possible to overcome this difficulty. This involves much more work than would naturally be supposed, but it is absolutely necessary for efficient working. The success of this New York and Philadelphia line was such that the company commenced the construction of a line from New York to Boston, carrying eighty wires. This also works perfectly, as I can testify from personal use. Extensions to Albany, Saratoga, Syracuse, Rochester and Buffalo, followed, and at this date thousands of miles of poles, and many thousand miles of wire are in use, the property of the before mentioned company.

The poles used in building these lines are of the best material procurable. Cross-arms are of pine securely fastened by lag screws, and braced with iron braces so that each arm is as rigid as the pole itself. The poles are put into holes much deeper than usual, they are tamped more carefully, and in soft ground cement, sand, and broken stone, make an artificial foundation. The poles are of course closer together than is usual in telegraph construction, and on curves the distance is again shortened. It is simply impossible, looking at it from a reasonable point of view, to build pole lines in a more perfect manner than the lines of the long distance company.

WIRE.

The wire is No. 12 B. & S. G. (.104 inch diameter) of hard drawn copper, with a resistance of 5.2 ohms per mile. All joints are made with the McIntyre sleeves, which seem to give as good a connection as any soldered joints, without endangering the strength of the wire by heating. Where many wires are required, ten are strung at a time, the ends of the wires being drawn from the drums by a team of horses. A long bar to which all the wires are fastened, is drawn along by the horses, and at each pole a lineman is stationed to lift the wires to the proper place. I need not say that in Canada we do not string ten wires at a time, but if we should ever find it necessary to do so, we have the experience of our friends in the States to guide us.

While the mechanical work on these lines is so perfect, great care is also taken that when erected everything shall remain in the finest order at all times. The route for the line is selected

with a view to as little interruption as possible from such disturbing elements as trees. Contracts are entered into for trimming, or in some cases removing them altogether. Poles are not put near gateways or near other poles. Long poles are used where the ground is low, and short ones when placed on knolls. In fact it is almost impossible to mention anything of advantage in the construction of a line of poles that has not been adopted by the Long Distance Company.

In Canada we have tried to do as good work as in the States, always keeping in view the fact that we cannot hope to get as good rates, and therefore construction expenses must not exceed a reasonable amount. The new lines now in course of construction have forty foot poles. The wire is No. 13 hard drawn copper; McIntyre joints have always been used, and transposing is carried out thoroughly. In future no pole less than thirty-five feet in length will be put up, except on unimportant routes not likely to ever carry more than a few wires. Care is taken that trees will not interfere, and in a general way every effort is made to secure a good working line, and one which will at all times be ready for work. In connection with this matter of perfect working lines I may point out that in long distance work, success can only be attained by uninterrupted service from day to day. In telegraphy a message is handed to a clerk; the message may be transmitted immediately, or it may be delayed for a long time? The sender, however, does not know this. In telephony, the person wishing to converse has knowledge of all delays. If the line is broken or interrupted in any way, he is aware of it, and if he has tried two or three times in a day to be connected to a person in another town, and does not succeed, he very naturally loses faith in the telephone service. Any person, giving a moment's thought to it can see, that the very essence of successful long distance work is its reliability.

EQUIPMENT.

In Canada the ordinary Blake transmitter is used on all lines. A good metallic circuit is so silent that a Blake is quite powerful enough for any line we have up to three hundred miles. In the States the Long Distance Company's offices are equipped with what are known as "long distance" transmitters, a modification of the "Hunnings," but many subscribers to the exchanges use the "Blake" for all long distance work. To subscribers who can afford it, long distance cabinet sets are supplied at a rental running as high as $60 per annum in addition to the ordinary exchange rental. Booths, handsomely ornamented, can be purchased at prices varying from one hundred to two hundred and fifty dollars. Every part is double, i. e. one box within another. When properly made and fitted such booths prove very satisfactory.

In the way of receivers, there is only one instrument to use. Practically no change has been made in the construction of the "Bell" receiver since it was first sent out fourteen years ago. It still remains the only instrument that will transform undulatory electric waves into sound waves audible to the human ear.

I can only glance at the remainder of the important points connected with equipment. The same care has to be taken inside the office—and in cables, devices for protection from electric light, lightning or other heavy currents, and in the central office switches—that is exercised outside. All instruments are bridged in, or to put it plainer, are in multiple arc, as each side of a metallic circuit must be alike in every respect—conductivity, insulation, and inductive capacity—or the line will not work perfectly.

Outside of North America the best line is that now working between London and Paris, the construction of which was complicated by the necessary cable across the channel, but all difficulties were overcome and the line works perfectly.

RATES.

In the United States the tariff is one cent per mile, with a minimum rate of fifty cents. Here it is just half that amount with a minimum of twenty-five cents. This applies to metallic circuits, but all circuits must soon be made metallic, so the foregoing may be considered as the settled rate. For short distances telephone users do not consider these rates too high, but when the distance is over two hundred miles they cannot understand why the amount should be increased. Our almost universal tariff of twenty-five cents for telegraghing a message of ten words has no doubt fostered this idea. The conditions, however, are entirely different, and telephone rates must be considered from the same standpoint as passenger or freight rates on a railway. A telegram going twelve miles, or twelve hundred miles in Canada, costs the sender the same amount, but in telephoning, as in railroading, the rate must increase with the distance. To convey a telegraph message to any point only one wire is necessary. Between large cities this single wire becomes two by being duplexed, or four by being quadruplexed. To convey a conversation by telephone we need *two* wires, so that under any condition the capacity of a telegraph line must always be double that of a telephone line, and may have four or eight times the carrying power if required. Nothing of this kind can be done with a telephone circuit. There is no practical way of increasing the capacity. In addition to this great difference in actual carrying power, the conditions in telephony are such that the disparity is still further increased. Even when subscribers are waiting to speak, it is doubtful if more than six or eight conversations per hour can be put on any line, whereas a telegraph wire will easily carry three or four times that number of messages, or keeping in view the fact that we need use two wires, it may be considered that the earning power of a telegraph wire exceeds a telephone line in the proportion of six or eight to one, and this is doubled or quadrupled if the telegraph wire is duplexed or quadruplexed. I need not point out also the great difference in the cost of construction. No. 13 hard drawn copper wire costs for metallic circuits say $80 per mile of poles, No. 9 iron wire, only $20. Long distance telephony has great possibilities before it. He would be a bold man who would consider that nothing more can be achieved. In my estimation the only difficulty is the commercial one. Next year we shall certainly see lines working from New York to Chicago, and how much further, no one can tell. Canada can claim to be the home of the telephone. In the way of use by the general public, it may be said, we lead. The villages, towns and cities of our country have more instruments in use in proportion to population, and at a lower rental, than any other country, and I have no fear that we shall ever fall behind in this respect.

The Chairman: As there are a large number of the telephonic fraternity present, I think we might have some remarks on the paper just read.

Mr. Fraser: As none of our friends feel inclined to discuss this subject, I take great pleasure in moving a vote of thanks to Mr. Neilson for the paper submitted to us this morning. He deserves a great deal of credit for the able manner in which he has handled his subject. Seconded by Mr. Throp. Carried.

The Chairman: I will now introduce to you, Mr. D. Thomson who will read a paper with "Central Stations" as its subject. (Applause).

CENTRAL STATIONS.

The time was, many years ago, when the name of central station for the supply of electric lights meant any old unused building or shed with just roof enough on it to keep most of the rain from coming through, and what did get through, which in some cases was considerable, had to be diverted from deluging the dynamos by means of oil cloth covers, &c., in many cases the dynamo attendant being compelled to dodge beams occasionally in his efforts to keep his machines in at least fair running order. The matter of dirt was only of secondary consideration most of the time. Very frequently an engine and boiler that had done duty in other capacities for a number of years was pressed into service as good enough to run a dynamo, the line shafting and pulleys frequently being some old rattle trap affairs that had worn out their usefulness long before being used to run electrical machines. No thought or attention was paid to the matter of a good lubricant for them, and as a consequence, hot bearings were the rule rather than the exception. Of late years this seems to have all been changed, and the prevailing central station of to-day is in nine cases out of ten a model of perfection in all its different parts, the efforts put forth seeming to be to improve in some points on previous ones erected, experience, the great teacher, pointing out defects and weak spots that are remedied in the new ones under way. We now find steam engines being used that are built one might almost say expressly for the running of electrical machinery, and that are as near perfect as modern steam engineering can devise. The boilers are the best that it is possible to procure, the buildings now being models of modern architecture, the aim in designing and erecting them being to have them of the most substantial material and to be in most cases almost absolutely proof against fire, with conveniences and safeguards to protect and make comfortable those whose duty it is to live in them, as it were, for the greater half of each twenty four hours. Dirt is a factor that plays no part in its existence, things generally being kept tidy, neat and clean. Nor can we stop here, for the matter of economical operation plays such an important part in the running of the plant in these days of low prices for lighting, that every exertion is used to produce the power in as cheap a manner as is consistent with good service. In time past when fabulous prices were obtained, this was not the case, the profits being so great that a few extra pounds of coal consumed was not noticed, but now that competition has brought the prices of lighting to just barely living profits, it becomes imperative that the operations should be carried on in as economical a manner as possible if the shareholders are to receive any return for their money invested. The securing of such return is undoubtedly their right, and one that must be of foremost consideration in central station management, for without the capitalists, where would the electrical interests, both in manufacturing of apparatus and the supplying of current in its various forms, be to-day? To sum up, then, just what a central station should consist of—the building should be one story high, built directly on the ground, with good and substantial walls of either brick or stone, set on well footed foundations, with peaked roof and fan lighted ventilators or windows running its entire length, the windows of which can be operated from the ground by means of levers. The material for the roof should be corrugated galvanized iron fastened to the beams and purlines, which are preferably made of angle iron, care being taken to see that the corrugated iron has some good fire proof non-conducting lagging laid under it to prevent the condensation of the moisture contained in the warm air inside the building from coming in contact with the cold roof. A proper tower should be provided at one end, or the center of the building, for the entrance of the necessary wires; markedly in contrast to the old plan of utilizing the wood work on top of any window or door that might be the handiest to honey-comb with holes for that purpose. Proper stone and cement foundations should be provided for engines,

shafting and dynamos, which must not have any connection with either the walls or the foundations of the building ; the floor to be preferably of concrete with a rock asphalt top of at least ¾ of an inch in thickness, except where there are pipes and pits that cannot be well covered with other material than wood, on account of the necessity of being able to get at them at any time; such wood floor should be at least 2 inches in thickness, of good red pine well seasoned, laid on good strong joists and beams, the beams being supported on brick or stone and cement piers suitably placed.

In the matter of engines, there can be no doubt that in stations of any considerable size (say from 100 H. P. up) the most suitable for the purpose are what are known as cross connected twin engines of slow speed, and where water is available for condensing purposes, they are preferably built with high pressure cylinder on one side, and low pressure condensing on the other, though where the boilers are such that very high pressure can be carried (150 lbs. or more), it is a question whether results just as beneficial cannot be obtained by using a third cylinder, and a consequent triple expansion of the steam admitted at the first cylinder at such high pressure. There cannot be any doubt whatever that such engines can be operated at considerable saving over the best of high speed engines that are manufactured, and these high speed can only be recommended for isolated or small plants where slow running single engines would be apt to cause a fluctuation in the lights when passing their centers, which in high speed is entirely eradicated owing to their velocity. In the matter of boilers, there can be but one opinion where tests have been made, and that is in favor of water tube boilers, such as the Babcock & Willcox, Crandell, Zell, or some other modification of them, for aside from the fact that they possess an element of safety that the ordinary return tubular boilers do not possess, they are quick and economical steamers and cost very little for maintenance. After the steam plant comes the belting, line shafting, and pulleys, which for satisfactory working should all be of the best. The shafting should be fitted with self oiling bearings, with oil reservoirs and ring feeders ; said shafting and the necessary hangers or standards, should be constructed in such a way and of such material that they will be capable of standing a strain equal to at least 100 per cent. more than that which they will be ordinarily required to carry. The pulleys should be of the grip or clutch type, built so as to be able to carry at least double their ordinary load ; such pulleys to be of such a design that if it should be necessary to stop one of the dynamos, both the pulley and the grip will stop together, and only the driving mechanism continue to revolve, thereby enabling the setting up of the grips or clutches on any one if required. This is the point that designers of central stations would do well to bear in mind. It has occurred in the writer's experience that where grip or clutch pulleys whose grips revolved with the shafting were used, it became necessary to stop an entire line of shafting together with the engine, to adjust one slipping clutch out of some four or five on the same line shaft, the pulley in that case being an elegant one in every particular but in this one point, that the clutch could not be stopped with the pulley.

Now to conclude, have your station fitted out with the best of dynamos and generators, and don't buy such apparatus simply because the price is low ; in fact cheap machinery is generally the dearest in the end. Let your switch boards be models of completeness, and have them kept so continually. Bear in mind that they are your distribution points, and that if they fail you, your entire plant will be jeopardized. Have your lines and circuits equipped with good and efficient lightning arresters, so that danger from this source will be a nullity. Make this part of your plant such that it can easily be got at, and if an arc should be caused through any means, have the necessary appliances at hand to break it as quickly as possible ; one of the best things for such purpose is a bucket full of dry sand. Last, but not least, let your station be a model of cleanliness and neatness ; have a place for everything, and see that everything is kept in its place.

The Chairman : The meeting is now open to the members or remarks.

Mr. Edkins : Mr. President, I move that this Association extend to Mr. Thomson a hearty vote of thanks for his paper on "Central Stations." Seconded by Mr. Taylor. Carried.

Mr. Yule : It seems a pity that more discussion has not taken place on these papers. I would like to ask Mr. Thomson what he would recommend in the way of surplus power. Some stations are built just large enough for present use and inside of a few years have to be enlarged ; others again go to the other extreme. What are your views, Mr. Thomson, as to the extent that surplus power and equipment can be safely carried out ?

Mr. Thomson : That is a thing that is pretty hard to provide for. I know of a case in Montreal where the central station was built just large enough for present use. The building was finely fitted up and everything in good order. In six months they had to enlarge. An addition was made—just large enough to meet the requirements, and in a few months more the building had again to be added to. I do not think it is possible to anticipate what the needs will be in that direction. It seems folly to build for future use unless you are sure of it being occupied. Our present building is too small for our business, and our new building, too large, but we calculate to fill the new one up in a short time. In a city like Hamilton or Toronto or Montreal, where all the city lighting is done by electricity, it is hard to tell what the requirements will be in two or three years, and the only thing is to build a station to meet the requirements. I do not think it is possible to anticipate how much surplus power will be required central stations, especially where there is a large and steady increase in the business.

The Chairman : I would like to suspend this discussion in order to introduce to the Convention, Mr. Larke, the Dominion Commissioner to the World's Fair, who has a few important matters to present to the meeting, and whose time is limited.

Mr. Larke : Mr. President, if you will permit me, I would like to correct a statement made by you just now when you called me the Dominion Commissioner to the World's Fair. The Commissioner for the Dominion, is Prof. Saunders, of Ottawa. I simply have charge of the Machinery Department at Chicago. As you are all well aware, it has been very properly thought by officials of the Exposition, that Canada should make a large exhibit at the International Exposition, and as Canadians we will admit that the larger half of the Continent ought to have some share in the Exposition. If Canada is to give us an exhibit at all it should be represented by the very best resources and industries, and it seems quite plain that this Association as one of the most active of its industries, should be represented there too. The exposition authorities have arrived at a proper conception of the development of the electrical industry, and have appropriated to its use a special department and special building. They are sure that there is no industry or organization in Canada which has so quickly attained the position which your industry has. The Dominion Government have seen this too, and have decided to bear the cost of transit there and return the exhibits free of charge. No duty will be levied. It seems to me that we are generally omitted on this side of the line, and the purpose of the exposition is to advertise Canada. We want to get rid of this delusion that our friends on the other side of the line have, that this is simply a country of forest and and frost. I think it is not too much to ask that your Association will do its proper share of the exhibiting on that occasion. It is not for me to advise you how to proceed, but I can say that anything I can do to assist you in the matter, so far as the Government is concerned, I will be delighted to do. The country is not represented as it should be, unless you are there present with at least some samples of the manner in which you are doing work, in the way of electrical inventions in machinery and other things.

Mr. Sadler : I would like to ask Mr. Larke what has been done in the way of motive power. Is there going to be any provision made for us having our machinery run by electrical power? I think it would hardly be right for us to take our Canadian machinery to Chicago and have it run by American engines. It should be so arranged that two or three Canadian engines could be taken to do the Canadian work.

Mr. Larke : That has not been considered yet, and I fancy it has never been thought of. I must say that one reason why we want an early application is because of our having to economize space. We made application to the Exposition authorities for a certain amount of room and a large proportion of that room has been promised us, but if, as it is supposed, the English people will not require all the room allotted to them, we as an elder brother, want to fall heir to it. I will make the matter known to Prof. Saunders at once, and I am sure that all he can do that will be to your interest, will be done. It certainly would be a large and very difficult undertaking to carry Canadian power to Chicago, yet I would very much dislike to see Canadian machinery running by American engines. It is a point upon which the Government should aid us. The cost of transporting such large engines as would be required, would be so great that the American Government might object to spending so much money in that way ; however, I shall be delighted to have the question brought before the Government.

Regular order of business being resumed,

Mr. Fisk : I would like to ask Mr. Thomson if it is possible to keep a self-oiling bearing from heating, and also what oil he finds best, and how often it requires changing ?

Mr. Thomson : Circumstances alter this to a very great extent. As far as the heating is concerned, the self-oiling bearing must have attention as well as anything else, of course. The oil should be changed about once a month, and I find the best oil is the ordinary dynamo oil.

The Chairman : I will now introduce to you, Mr. H. O. Fisk, of Peterboro', who will read a paper on "Carbons."

CARBONS.

It was suggested at one of our committee meetings that I should prepare a paper for this convention on "Carbon Testing," but the time was too short to carry out a series of experiments as at first spoken of, so instead, I have prepared a short description of the process of manufacture of carbon points, as conducted at the factory in Peterborough.

Carbon is an elementary substance, occurring in nature uncombined, as the diamond and mineral plumbago. It is much more abundant, however, in a state of combination ; thus it occurs in union with oxygen in the carbonic acid present in the atmosphere, and in combination with oxygen and calcium, forms in the shape of limestone a large portion of the earth's crust. In union mainly with hydrogen, it is the chief constituent of coal and mineral oils, and along with oxygen, hydrogen and nitrogen, is an abundant ingredient of animals and still more so of plants. It exists in several altropic forms, that is, forms which

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EDITOR'S ANNOUNCMENNTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

THE "CANADIAN ELECTRICAL NEWS" HAS BEEN APPOINTED THE OFFICIAL PAPER OF THE CANADIAN ELECTRICAL ASSOCIATION.

THE Great Western Railway of England, known as the Broad Gauge Road, recently abandoned its 7 feet gauge and adopted the standard 4 feet, 8½ in. gauge. In twenty-five years it had 1,450 miles of broad gauge. This had been gradually reduced till last month there remained only about 200 miles to change. The work was completed in 31 hours. Trains run on the Great Western of England at a higher speed than we have yet been favored with in Canada. The "Flying Dutchman" makes a journey of 194 miles in 4¼ hours. Another train makes 246¾ miles in 6 hours and 10 minutes. The speed of the "Flying Dutchman" would take a train from Toronto to Montreal in 7 hours and 20 minutes. When shall we get it?

MESSRS. Yarrow & Co., London, Eng., recently performed a feat in ship building worth recording. The French Government wanted a shallow draught flat bottomed boat for service in Africa. It was wanted in a hurry in order to chastise some of the natives in Daleomey. Attempting to get one built in France it was found that four months was the shortest time in which any of the French builders would undertake to produce the vessel. The order was given to Messrs. Yarrow & Co. on 28th April, and on the 25th May, the vessel was in the water and steam up. On the 26th May, her official trial trip was made to the satisfaction of the French officers. The boat is 100 feet long, 18 feet broad and with ordinary load draws 18 inches. She made a little over 10 miles per hour, and can carry 400 troops.

THE "Royal Sovereign" a recent addition to the British navy, is said to be the most powerful war vessel ever constructed. Her steaming capabilities were tested a few weeks ago, and the power developed was in excess of that called for under the contract. Engineers will be interested in knowing that the main engines are triple expansion driving twin screws in the usual way. The steam is supplied by eight boilers carrying 155 lbs. pressure. The boilers have 700 sq. feet of fire grate, and 19,560 sq. feet of heating surface. With ordinary natural draught to the furnaces the power developed was 9760 horse power. With forced draught equal to 1 6/10 inches of water, the steaming capacity of the boilers was so much increased that 13312 horse power was obtained. Neither the coal consumed nor the water evaporated, appeares to have been measured. As the engines are triple expansion, and steam at 155 lbs. pressure, it may be assumed that not more than 16 pounds of water per horse power, per hour, was required. On that basis each sq. foot of fire grate under natural draught, evaporated with steam at 155 lb. pressure, 223 pounds of water per hour; and each sq. foot of heating surface evaporated nearly 8 pounds of water per hour. With forced draught the evaporation was increased to such an extent that each sq. foot of fire grate evaporated 304 lbs. of water per hour, and each sq. foot of heating surface evaporated 11 4/10 pounds of water. The power developed was increased nearly 34% by the use of force draught and with it each sq. foot of fire grate supplied steam enough for 19 horse power. The present tendency is in the direction of higher steam pressure and hotter fires, and the results obtained from the Royal Sovereign's boilers and engines show that those who are looking for economical steam power should work in these directions. A steam boiler and engine, such as are commonly employed in factories here, and yielding 80 horse power, to be equal in efficiency to the Royal Sovereign's machinery, would require to give about 400 horse power. An ordinary tubular boiler with 20 sq. feet of fire grate would be considered as doing well if 70 horse power were obtained, but 20 sq. feet of fire grate in the Royal Sovereign gave 380 horse power.

THE present number of the ELECTRICAL NEWS is largely occupied with a full report of the first convention of the Canadian Electrical Association held in Hamilton on June 14th, 15th and 16th. The occasion, which was marked by favorable weather and the attendance of about seventy-five members, must be designated a pronounced succcess. At the meeting of the Executive Committee immediately preceding the opening of the Convention there were elected nearly forty new members, bringing the total membership up to 110. This is equal to half the membership of the National Electric Light Association of the United States at the time of the Montreal Convention last year, and is certainly a very satisfactory record for an organization the lifetime of which covers a period of only seven months. The programme prepared by the Executive Committee proved to be sufficiently extensive and varied to fully employ the time and attention of the members throughout the convention. There was little time lost and no opportunity afforded for the proceedings to lag; from commencement to finish everybody was wide awake and the meetings were marked by a vim and interest which was highly gratifying to all concerned. The papers read, touched upon matters of interest relating to all departments of electrical progress, and opened up fields for discussion which possibly were taken advantage of to as great an extent as could have been anticipated in any assembly where most of the delegates met as strangers and consequently were inclined to feel timid about rising to express their opinions. In this connection the suggestion might be made, that if at future conventions abstracts of the various papers to be read were printed and placed in the hands of the members at the opening of the meeting, it would doubtless prove an encouragement to free and well considered discussions. It was a matter of some surprise to see the telephone interest better represented than that of electric lighting. Besides the fact that a much greater number of persons are engaged in the electric light business than in the telephone industry, there is popularly understood to be in the former field greater possibilities for change and improvement and consequently greater opportunity and necessity for the acquirement of new ideas. The many young and bright minds by which the telephone interest was represented at the convention, however, is in itself proof that the limit of progress in that department has not been reached. We may presume that the electric light, power and railway interests will see the importance of being adequately represented in future conventions. The visits to the Bell Telephone Company's new exchange and the Light and Power Company's new central station, were regarded as valuable object lessons by most of the delegates. The Association expressed its satisfaction with the work of the officers, by re-electing most of them for another year, while the worth of the president, Mr. J. J. Wright, was fittingly acknowledged by the presentation to him of a handsome gold watch. The social features of the occasion, including a drive to some of the principal points of interest in the city and a luncheon and band concert at the Beach, served to impress the visitors with the desirability of Hamilton as a place of residence and the hospitality of her citizens. In view of the desirability of holding a convention and electrical exhibition in connection with the Toronto Industrial Exhibition of 1893, it was thought advisable that a meeting should take place midway between that time and the present. It was accordingly decided that the Association would meet in Toronto in January next. A member of the Board of Directors of the Montreal Exhibition Association extended a cordial invitation to the Association to hold its convention of 1894 in that city, promising that every facility and encouragement would be afforded for that purpose. It is altogether probable that this invitation will be complied with. The question of annual versus semi-annual conventions has already arisen. The fact that the National Association of the United States has abandoned semi-annual in favor of annual meetings seems to be a strong argument against the wisdom of attempting to hold annual meetings of the Canadian Association. No doubt, when the matter comes up for consideration, it will be discussed from all standpoints and will be wisely decided. In the meantime it is the duty of every member to feel encouraged by the success which the Association has already achieved, and to make personal effort to increase its membership and usefulness to the utmost extent.

(Continued from page 99.)

differ from each other in many physical and some chemical properties, but which nevertheless consist of nothing but single element.

Wood carbon, or charcoal, is prepared by heating wood in iron retorts as long as it evolves anything volatile. When coal is treated in the same manner, as it is in the manufacture of coal gas, the excess of carbon is in like manner left behind, forming a hard shining light solid, valued as an economical and powerful fuel. This substance, which is literally charred-coal, and therefore best deserves the title of charcoal, goes nevertheless by the name of coke. A variety of this material is found in the upper parts of the gas retorts, and is probably formed by the decomposition of gaseous compounds of carbon and hydrogen. It is very hard and porous with almost a metallic lustre, and is a good conductor of heat and electricity, but this is of little value, if any, in the carbon business. However, 25 per cent. of this coke mixed with 75 per cent. of petroleum coke, is said to make a good carbon for low tension work. Another variety of this material is obtained from the oil regions, commonly known as petroleum coke. This is a by-product of the oil stills, and is the only kind used to any great extent in the manufacture of carbon points for the electrical industry. It is of primary importance that the coke, and in fact all the ingredients used, be absolutely free from impurities. Sulphur, iron and dirt (by dirt I mean shale sand and other foreign matter which by careless handling may get in) are the impurities frequently met with, but sulphur is by far the worst the carbon maker has to contend with ; but by using the very best of coke which is obtained from Pennsylvania oils, trouble from this source is reduced to a minimum. The other constituent of our carbon is pitch. This is made from coal tar which is a by-product of the gas retorts. It may also be obtained from blast furnaces, but this kind is more or less contaminated with iron, and therefore is unfit for this class of work. Pitch for this particular purpose is difficult to obtain, as the makers do not care to expose their still to the high temperature necessary to drive out all of the oil, and reduce it to the proper specific gravity, and as the men in the factory say, "it is more or less wet."

The first step in the process of manufacture is that of crushing the coke. This is accomplished by means of a machine somewhat in appearance like a mammoth coffee mill. The coke comes from this crushed to about the size of coarse gravel ; it is then automatically elevated to a large bin in the upper part of the factory, and from there it is conveyed to a large iron hopper situated directly over the calcining retorts. Into these the granulated coke is conducted by means of spouts with gates arranged to control the flow of material into the several aforementioned retorts. They are then sealed up, thereby preventing combustion, with the exception of a few vents to allow of the escape of gas, arising from the heating of the coke to a state of incandescence, which point is reached in from twenty four to forty eight hours after firing. After this if the coke is not pure it will be found to have caked, necessitating in some cases the use of bars to break it up sufficiently to allow of it being drawn from the retorts. If pure it will appear crisp and dry and to have suffered a loss in weight of about 30 per cent. After retorts have been drawn sufficently long to allow of cooling, their contents are elevated to the milling department and run through a set of French burr stones incased in iron, very similar to the grist mill chop stones ; then through a silk bolter separating the coarse from the fine, the former returning to the milling machine, the latter being conveyed to bins with suitably arranged spouts over scales from which it may be drawn and weighed as required by mixing department. We will leave the coke here for the present and return to the other ingredient, namely the pitch. This is a dense, hard solid, very brittle and dry, and in appearance some what resembling gutta-percha. This material when it reaches the factory is incased in casks, holding about 600 lbs. each. It is then broken up by the men into a convenient size for handling, and subjected to a granulating process similar to that of the coke ; finally we find it at a spout close beside the one from which the coke can be drawn.

We have now followed the two principal ingredients through the various processes which were necessary to prepare them for the mixing room. The other ingredients, if any, we shall not be able to elaborate upon, until we have reached a more confidential relationship with the carbon makers. However, upon the manipulation of the materials at this stage, I am told the success of the future carbon greatly depends, in fact the great secret lies in the mixing. We can better understand the skill and care required to properly amalgamate the mixture, when we learn that each particle or grain of coke must have its individual coating of pitch, and it may be interesting to learn that this coke is ground so fine that a grain magnified a thousand times would only appear the size of a shot. To obtain these results the materials are carefully proportioned by weight, and placed in a mixing barrel. This is a rotating cast iron cylinder within which, revolves, in the same direction and twice as fast as the cylinder, an independent shaft, to which are attached arms so arranged that every part of the barrel is covered or swept in each revolution. This is attached to a furnace in such a way that the flues follow the whole circumference of this barrel maintaining a uniform temperature of about 300° F. which is necessary to bring the pitch to a state sufficiently plastic for amalgamation ; thirty minutes is the time required for each batch, which would make about 1,600 carbons. From this machine it is taken to the cooling room and spread out for ten or twelve hours to cool. Here the mixture solidifies to such an extent that it becomes necessary to pulverize it again, to perfect it for the moulds. This end is attained by means of a mill, the pulverizing feature of which is two discs thirty inches in diameter, with corrugated face plates revolving in opposite directions at the rate of fifteen hundred revolutions per minute (about one one-hundredth of an inch apart). From this it is once more passed through a bolting machine, and then finding its way down gravity tubes to a bin on the floor below (which is the moulding room) it is carefully weighed out by the workmen on peculiar little scales with clock like dials, in quantities just sufficient to fill each mould as it comes hot from the oven. It having been previously lubricated with some heavy oil, is now ready for its charge, which the operator plases in it and works evenly over the whole surface with a spatula, to insure uniformity of density. The cover or top half is placed in position and the mould and its contents passes for a few moments into an oven, the temperature of which is about 300° F. As soon as the mixture has become quite adhesive the mould is placed in the hydraulic press, and subjected to a pressure of several hundred tons. This press consists of a cylinder and base, kept in position by four steel columns weighing nearly a ton each. Within this cylinder (which is eleven inches thick and copper lined) is a ram or plunger thirteen inches in diameter making a stroke of three inches. Connected with this press by a feed and return pipe is a triple cylinder pump very powerfully geared pumping a stream of water continously through the feed pipe, press cylinder and return pipe. By simply closing a valve at the press on the return pipe, the pressure at once begins to accumulate under the ram, and in fifteen seconds the enormous pressure of twenty thousand pounds per square inch is attained. Then the release valve is opened, and the whole apparatus as though possessed of life gives a groan of relief. The mould is now removed and opened, and we have a corrugated card containing sixteen or eighteen carbons, each one being joined to its neighbor by a fin which is inevitably formed when subjected to the enormous pressure before mentioned. These cards are placed on plates which are fitted to receive them perfectly. These plates with their contents are piled up and weights placed thereon to prevent warping. When cool they are broken apart, gauged for size, culled, and the fin scraped off. They are then laid in the furnace for baking. This furnace is rectangular in shape 34 x 11, four feet deep and made of fire brick, and is similar to a large vat set about two thirds below the surface of the earth. Over this when filled is placed a dome shaped cover, sufficiently high above the sand and tile which covers the carbon, to allow of a free passage of the flames, and which is continued by flues back through the sides and also underneath, thus completely enveloping the body of the furnace in flames. The carbons are carefully placed in the furnace and separated from each other with washed sand, which is brought from the shores of Lake Ontario. Some days are required to completely load a furnace, as each section will hold about seventy-five thousand carbons. The cover having been placed in position and sealed with fire clay, the fire is now started, crude oil being the fuel used, as as well as in the case of the retorts and moulders' oven. The supply is held in a 250 bbl. tank by a railway siding some two hundred feet from the building, and connected by underground pipes to the various points in the factory where required, each branch terminating in a patent burner, which to the writer very much resembles a huge lineman's torch, with the exception that steam is used to spray the oil and perfect the combustion. This fire is continued moderately for 48 hours to allow of the gas escaping without blistering the carbon ; it is then forced to its utmost for from forty eight to sixty hours longer, then shut off, and the whole allowed to cool for forty eight hours before uncovering. The top, which is mounted on wheels, is then rolled off and a few carbons taken from various parts of the furnace and tested by a Wheatstone's bridge and galvanometer for resistance, as this at once determines if the baking has been carried sufficiently far. If the measurements of all the samples exceed four-tenths of an ohm, the furnace is re-covered and fired for some hours longer, but this very rarely has to be done. The writer recently tested samples from the north and south ends and centre of a furnace, and they measured 23, 22, and 24 one-hundredths of an ohm respectively. Some difficulty was at first experienced in attaching carbon to the bridge, for the resistance of this substance as you are all well aware varies considerably, as the pressure of contact, and the same carbon measured at different times would often vary several one-hundredth of an ohm. But an instrument was designed by the writer which obviated to a great extent if not wholly this trouble. The pressure brought to bear on the sample undergoing test by this instrument is determined by small weights suspended from levers attached to holders so arranged that exactly the same pressure and contact is formed on different samples of the same size. If the resistance of the samples as before mentioned, shows that the contents of the furnace have been sufficiently baked, it is unloaded, the hot carbon being handled with forks. When cold they are sorted, the first and seconds being easily determined by rolling on level steel plates. After this inspection they are ready for the plating room, where they receive their copper coat by being hung in leaden vats containing a saturated solution of sulphate of copper. These vats, of which there are several dozen, are connected in series

with a twenty ampere constant current dynamo. Twenty minutes to half an hour is the time required to complete this plating process. They are then washed in hot and cold water and placed on racks to dry, after which they go to the packing department to be rolled in paper and boxed for shipment.

I am indebted for a great deal of the above information to Mr. Taylor, the genial manager, who not only patiently answered my many questions, but allowed me, with camera, perfect freedom throughout the entire factory, thus enabling me to obtain and show photographs of some of the apparatus which will give a far better idea of the same than the meagre description you have just listened to.

The President: I think that is one of the most valuable acquisitions to electric literature. The process of manufacturing electric light carbons has been little understood, and apparently Mr. Fisk has taken a great amount of trouble to illustrate this process by means of photographs.

Mr. Saunders: I have much pleasure in moving that we tender a vote of thanks to Mr. Fisk for the paper which we have heard. Seconded by Mr. Smith. Carried.

The President: I think if we could just start a little discussion on this paper we might get a great deal of valuable information about these arc-light carbons. There are a great many users of them present.

Mr. Thomson: For the sake of discussion on this paper, perhaps Mr. Fisk will be in a position to tell us why we have long life carbons and why we have short life carbons, and why it is that sometimes out of 1000 carbons perhaps we get 900 that are short life and others that won't burn at all. Perhaps Mr. Fisk will be able to account for the fire-works.

The President: You want the earth. (Laughter).

Mr. Fisk: I might say, Mr. President, with regard to the fire-works, that that lies very much in the adjustment of the lamp. (Laughter.) In regard to the long and short life of carbons, I think I had better refer you to Mr. Taylor; he can probably account for this better than anyone else.

Mr. Thomson: No matter how the lamps are adjusted, we can get nothing but fire-works out of them. I have some carbons in from the United States, and a large percentage of these are fire-works carbons. Of course these are all right for Saengerfest occasions or special demonstrations like that, but I do not like them for general use.

Mr. Fisk: I may say, Mr. President, that my paper was a description of the factory as conducted in Peterboro', and not in the United States. I would refer your questions to Mr. Taylor.

Mr. Taylor: I would like to have been an outsider in this discussion. It relieved my mind considerably when Mr. Thomson said he had fire-works carbons from the United States. We have had a great deal of this kind of trouble too in manufacturing them. With regard to the flaming of the carbon and the long and short life, I may say that these qualities depend a great deal on the density; there is a great difference in the manufacture. At our factory we have occasionally got out a lot of carbons that lived much longer than anything we had ever produced, and the next lot, with apparently the same preparation, would perhaps be a great deal shorter. The quality of the carbon depends upon the uniformity of manipulation, and that is the cause of our getting better carbons to-day than we did six or eight years ago.

Mr. Thomson moved the following resolution, fixing the standard of current in amperes, seconded by Mr. Starr: "That it is the unanimous opinion of this Association that when the carbons in an arc lamp are the proper distance apart, to give their maximum amount of light without either flaming or frying, that the strength of current for a 2,000 (nominal) candle power arc shall not be less than nine and a half amperes; for a 1600 (nominal) candle power arc it shall not be less than eight amperes; for a 1200 (nominal) candle power arc it shall not be less than six amperes, and for an 800 (nominal) candle power arc it shall not be less than four amperes."

Mr. Johnson: Mr. President, I think this is a matter which requires a little more consideration before the question is put to the meeting. There is one thing which should be considered, and that is the voltage of the lamp. As the units are obtained both from the voltage and current, in the same measure is the light obtained. It does not profit the company or manufacturer in the slightest to force a heavy current through their carbon points, without getting the benefit of that current, and that benefit is obtained by a separation of the carbon points. It is necessary in order to adjust the lamp, to take the standard current in the line, and the average of each individual lamp or the voltage current they are all supposed to be adjusted to. If there is any standard adopted, it is only fair to all manufacturers that the resolution shall be an average on which the lamp is standardized, as it is possible to use a heavy current and waste half of it heating up the ends of your carbons. It is best to use the current and voltage proper to the lamp you intend to sell, and give the separation which your lamp and machine will stand, suitable to your own requirements. There is another point to be considered, and that is, that the final measurements must be made by some other means. It is true that the current and pressure should be taken into consideration, bnt there is also a voltage to to be obtained by these lamps and the position of the carbons should be defined. It would be better in measuring, to define what the height of the lamps would be and at what angle they should be adjusted. The question for us to decide is not what is best for the manufacturers, but what would be of most benefit to the general public.

Mr. Campbell: With regard to the pressure of the arc lamp, I would like to ask how you can account for the difference in the pressure at different times. I have seen lamps which one minute would be 30 or 35 volts and a minute later 50 or 55 volts; I would like to know how you can account for this change in the voltage of a lamp?

Mr. Fisk: I have seen the lamp alter 3 or 4 volts, it is true, but I do not see the necessity of its varying much more than that.

Mr. Starr: I do not think this is a matter which should be looked at from a manufacturer's standpoint. I think it is generally understood by electricians that the standard we have adopted in this resolution has already been adopted in the United States and Europe. It seems immaterial whether the manufacturer uses 10 volts and 40 amperes, or 40 volts and 10 amperes, as long as the power is produced; the results are all the same for the manufacturer. But I think the interest of the public should be looked after, and there should be some standard adopted as a safe-guard against them being swindled in any way. It is possible for a manufacturer to supply a 1200 candle power light at the same price that he gets for a 2000 candle power light.

Mr. Johnson: I certainly agree with Mr. Starr, that it makes no difference whether volts or amperes are used, but let me say that the power produced is merely nominal candle power. If we are going to take what has generally been accepted as candle power, it is usually accepted because the first company started with that rating of candle-power. Scarcely any 2000 candle power lamp is 2000 candle power or anything near it; no matter whether it is 9 ampere or 8 ampere, it is not 2000 candle-power.

Mr. Thomson: I think, Mr. President, that some of our members do not understand that a good arc of many amperes will produce so much candle power and no more, no matter how hard you try. If the current is 8 amperes strong, it will produce a certain voltage, or 9 amperes, it will produce a certain voltage, if it is a good arc. It is bound to take a certain amount of current to regulate an arc.

Mr. Nicholls: I did not intend to take part in this discussion, but as one of our members has suggested, it would be very unfair to pass such a resolution as this at the present meeting. It would be very unwise to introduce a matter that is going to cause such a disturbance. I understand that there are not more than 12 gentlemen present who are representatives of arc-light manufacturing companies, and I think that the proper way of bringing forward a resolution of this character would be to give notice of motion, especially of a question which is going to revolutionize to a certain extent the working of one department of this Association.

Mr. Dunstan: I also have taken a similar objection. This is a matter for very serious consideration, whether this Association should or should not fix this standard, and I think it would be wise to defer the whole matter until next meeting.

Mr. Nicholls: I move, in amendment to Mr. Thomson's motion, that further discussion on this matter be postponed until the next meeting of the Association.

Mr. Yule: I very heartily second Mr. Nicholls' amendment, and especially in view of the threatened legislation to fix a standard, I think our best plan is to await proceedings.

Mr. Dunstan: I heartily sympathize with what Mr. Nicholls has said. I think that this is a matter which should be referred to, and thoroughly discussed by a special committee, who could report at our next meeting.

The President: Some gentleman stated that the resolution as introduced would cause a disturbance, but I know that that idea was farthest from the mover's and seconder's mind. If any standard is fixed it is only that the manufacturers would then all be working on the same basis.

Mr. Yule: The time is not far distant when the Legislature of Ontario or the general Government will fix a standard.

The amendment being put to the meeting, was declared carried.

The morning session then adjourned.

AFTERNOON SESSION.

At 2 o'clock the members assembled at the building of the Bell Telephone Company and spent a profitable hour inspecting the new exchange.

When business was resumed at 3 o'clock, the Chairman announced that the first order would be the determination of the time and place for the holding of the next Convention.

Prof. Rosebrugh: Mr. President and Gentlemen—In case it should be decided to hold the next meeting of the Association in Toronto, I should be very happy to invite you to meet in the School of Practical Science. (Applause.)

The President: There is another question, as to whether we shall hold our meetings annually or semi-annually.

Mr. Dunstan: To start this matter I might say, that it is necessary, us our President has just announced, for us to decide whether our meetings shall be annual or semi-annual, and a great deal is to be said on both sides of the question. This is a young Association, and we have to feel our way—we must not become too impatient all at once. The question is, whether it is wiser to divide our strength by holding our meetings semi-annually, or to confine ourselves to the one meeting and make

that meeting a success. We want all the members of the institution to come to our meetings, but we must not forget that when some have to travel a long distance the expenses amount up, and I would rather see one well attended meeting than see two meetings with the attendance divided. Our Association is too young to risk holding semi-annual meetings.

Mr. R. Æ. Kennedy: As President of the Hamilton Electric Light and Power Company, I would like to say a few words on this subject. I, for one, greatly favor holding our meetings semi-annually. In the United States we find our electrical friends meeting twice a year, and the interest created by these meetings amounts to a great deal more than the expense in connection with them. I think, too, that they would be well attended; we will try to allow our manager time to go to all the meetings, and perhaps our president too, but to create interest in these meetings, we ought to meet every six months. Of course we do not expect you to meet in Hamilton every time; suppose you try Toronto, Kingston, London, etc.

The President: I would like to suggest that in view of the Toronto Exhibition, in case we decided on the institution of an Electrical Exhibition, that that cannot well be done until a year from next September.

Mr. Kennedy: Of course, taking this matter into consideration and our exhibit at the World's Fair, we would have to meet before a year from now to compare notes.

Mr. Thomson: It would be well to divide the time up, between the Industrial Exhibition and now.

Moved by Mr. Smith, seconded by Mr. Burran, that the next Convention be held in the City of Toronto, in the month of May, 1893.

Moved in amendment by Mr. Carroll, seconded by Mr. Kennedy, that the Association meet in September next, in Toronto.

Moved by Mr. Thomson, seconded by Mr. Kammerer in amendment to the amendment, that the next meeting be held next January in Toronto.

Mr. Kennedy: We want to meet twice before the World's Fair.

The President presented the question to the meeting, and the amendment to the amendment, carried.

Moved by Mr. Nicholls, seconded by Mr. Thomson, that the proceedings of this Convention, including papers read, etc., etc., be printed in pamphlet form, the Executive Committee to appropriate a necessary sum of money therefor. Also that they be distributed to all members of this Association and to all persons who might be supposed to be interested in electrical matters.

Mr. Dunstan: Before this is decided I would like to call attention to one question: Is it wise or is it not, to give the proceedings to those who are not members? I think that one of the inducements held out by this Association to bring in new members is, that the printed proceedings of these meetings will be sent to them. It is a question whether we will gain new members by distributing free to outsiders the proceedings of this meeting or by saying, "before you can get the proceedings of this meeting, you must become a member of this Association." I would like the matter discussed a little before it is decided.

Mr. Thomson: I think, Mr. President, it would be wise to distribute this report free to outsiders; it would let them see what the Association is doing. I think it would benefit us greatly to throw the report around broadcast.

Mr. Hunt: I think that any man who is interested in electricity cannot help feeling interested in us, after reading what has taken place at our meeting and that Mr. Thomson is right in his views that the report should be distributed freely.

Mr. Kennedy: We want to develop this Association, and by spreading our news all over the country, we are going to be made more popular. The more who get hold of our Reports, the more our membership roll will increase. The motion carried.

Moved by Mr. Johnson, seconded by Mr. Kammerer, that the name of Mr. E. S. Edmonson, of Oshawa, be added to the Legislative Committee. Carried.

Mr. Sadler: I would like to ask with regard to the Government Commissioner, if it is the intention of the Executive Committee to take any steps to further the interests of this Association and the mechanical interests at the World's Fair, in any shape or form? The question I asked this morning was: What motive power is to be supplied to run our Canadian machinery at the Exposition? as it is in our interests that any motors used should be Canadian motors. This is a question I want to get at. I do not want to go to Chicago and see our Canadian machinery running by American motive power. I think the Executive Committee should take some steps and interview the Government officials for the purpose of inducing them to allow Canadian motor power in connection with Canadian machinery. The Government should be asked to offer some further inducements than paying freight to and from Chicago.

The President: I think the Executive will look after that matter. Mr. Baylis will now read a paper on "Multiple Switchboards."

MULTIPLE SWITCHBOARDS.

There is nothing that marks the latter half of the 19th century more distinctly than the growth of the electrical industries; and of all the applications of electricity, there is none that has made more rapid progress than the telephone industry. Twenty years ago there was no speaking telephone; ten years ago there was but little known about it, and by many it was regarded more as a curious electrical toy than as a future important factor in the advancement of civilization. Although the industry has reached its present state in a comparatively few years, yet the growth has been gradual, and improvements have been, and are constantly being, added as the necessities of the service demand, and it is to the needs of the operating room that most of the ingenuity of telephone inventors has been directed.

It would be impossible in this paper to attempt to describe, or even enumerate, the many forms of switching apparatus that have been invented, or are in use; I will confine myself to describing what is to-day regarded as the most perfect switching apparatus we have, viz., the multiple switchboard, the most elaborate and complicated electrical switch there is.

The telephone, transmitter, and magneto, in use in a small town where there are fifty or a hundred subscribers, are practically the same as those used in a city where the list shows thousands of names, yet the switching apparatus of the central is entirely different. In an office containing from fifty to seven or eight hundred subscribers, the switching is a comparatively simple matter. The switch which is in most general use in Canada in such places, is known as the Standard Switch, and it is, on the whole, a very satisfactory machine. When a subscriber has rung for the central and his annunciator has been actuated, the operator takes up any plug upon the table and inserts it into the jack of the subscriber calling, and cutting in her telephone by means of the switch which is in circuit with the pair of cords she is using, asks the subscriber whom he wants. If the line asked for is not in use, the connection is completed with the second plug, and the subscriber rung up. When the conversation is finished, the bells are again rung, and the current actuates a drop which is in circuit with the pair of cords in use, and the operator is notified that that pair of cords is idle and disconnects the subscribers. Now suppose a subscriber calls for another whose line comes into a switch several feet away and the cord will not reach, then recourse is had to short trunk lines, connecting the different boards. Each switch has lines running to every other switch, and in this way each operator can have connection with all the others. This system works all right when there are not more than 800 or 1,000 subscribers. If there are more, the number of trunk lines between the switches becomes so great that confusion may arise, and connections cannot be made quickly. Then, too, there are many chances for misunderstandings between operators, and mistakes are liable to occur. Thus the want was felt for a board on which each operator could make direct connection with every subscriber in the exchange without asking another operator for it, and without moving from her seat. As a result of this want, the multiple board was invented, and, on the whole, it has proved to be very satisfactory.

Very many forms of multiple boards have been invented, but the board of the W. E. Co. of Chicago is the one that has been most favorably received, and it is some form of W. E. board that may be found in almost every large telephone exchange in the U. S. and Canada to-day; a large number have also been installed in foreign countries. The boards in use in Canada are all made in Montreal in the Telephone Co.'s own shops. When multiple switches were first introduced metallic circuits were a rarity, so the board was designed for grounded lines only, whereas now, owing to cross-talk, electric railways and other disturbing influences, metallic circuits have become a necessity, and, in the large cities at least, every multiple board installed to-day is fitted for both grounded and metallic lines. From the time the first board was built until now, the form has been constantly changing, and even now no standard has been arrived at, and it is altogether likely that the next board built will be entirely different from all its predecessors. I suppose most of you have seen the Bell Telephone Co.'s new board here; this is a type of the most recent board in use, and it is with a switch similar to this that most of the large exchanges in the U. S. are equipped.

The general form of the board is vertical, about six feet high, and is made in sections six feet long. The upper portion of each section is divided into six panels. In these panels there is a spring-jack for each subscriber in the exchange. The jacks are arranged in groups of 100, made up of five rows of twenty. Each group is numbered from 1 to 100 and the number denoting the particular hundred is painted on the frame-work of the panel. The first group (the bottom left-hand one) is numbered 0, the next to the right 1, the next 2, and so on to the 6th panel, then another row from left to right, thus building upwards and allowing for future additions. Every one of these jacks appears in each board, so that the connecting places of subscribers are multiplied, hence the name multiple. The annunciators of the subscribers are situated below the jacks in a sort of trough. To facilitate answering calls, the lines of the subscribers are brought back to special jacks, which are placed below the ordinary multiple jacks, and are called answering-jacks.

Every thing is arranged for metallic circuits. The two wires of the subscriber's line enter the first board; one wire is soldered to the brass body of the jack and the other to a German-silver spring which rests on a brass stud. The wire coming to the body of the jack is carried right around the board from section to section. This is called the test or return side of the circuit. The other is the line side. The line after reaching the spring, passes to the stud, and from there a wire is led to the spring of the corresponding jack of the next section, and this is repeated for the length of the board. From the last section the wires from the multiple are brought back to the section that contains the annunciator of that line, and to the answering jack. Before reaching the annunciator, however, the line passes through the intermediate distributing board. The object of this board is to provide a means of placing a subscriber and any annunciator, and still not to change his position on the multiple part of the board. For example, suppose the operator looking after lines from number 225 to 300 was very busy, and say number 250 was an exceptionally busy line, by making a change on the intermediate board number 250 can be taken off this section, and put on to any spare annunciator on another board, and yet any operator wanting number 250 will find it in its regular place in the multiple part of the board.

The annunciator used now, is of the tubular form, and consists of a coil of 500 w. of 36 wire wound over an iron coil and surrounded with a tubular iron jacket, thus giving a more perfect magnetic circuit. It is very sensitive and occupies but little space. The subscriber's jacks were first made separately, but now they are formed in rows of twenty mounted in an ebonite strip. In a multiple board there may be many sections, on each of which is found every subscriber in the exchange, so it is evident that before connecting a subscriber's line on one table some means is required of ascertaining if that wire is in use at another section. A test for this is necessary on any multiple system. There have been many methods suggested and tried to provide the "busy test," but the system used on the Hamilton board is almost as successful as any yet tried on metallic circuit boards. Nevertheless, a great deal of the complication and trouble on the board is caused by this test. The test merely consists of putting one pole of a battery, the other pole of which is grounded, to the brass part of the jack. The operator is provided with a peculiar telephone having two coils joined together and the junction being grounded. Now if an operator wishes to ascertain if the line is in use, she merely touches the tip of a front plug on to the brass of the jack. If the line is idle no sound is heard in the telephone. If it is in

use a sharp click is heard, caused by the current from the battery which is connected to the plug in the jack passing to ground through one half of the head telephone. The ring off drop is 500 w. bridged across the circuit, and of high self-induction and does not materially lessen the speaking effect. To ring a subscriber the two sides of a small magneto are brought into a circuit with the two conductors of a cord, at the same time the other cord of the pair is cut off, thus signalling only the party desired.

The test is the same for single and grounded lines, but in a grounded line the bodies of the jacks are grounded through 500 w. This is to prevent short circuiting the test battery and also to offer resistance to earth currents which tend to throw the drop. The great disadvantage about this busy test is that one side of the line is used for the test circuit. It is found on long lines that the static charge held by the line often gives a false test, making it necessary to ground the line at the drop, as well as grounding the bodies of the jacks. Again a very little throws the test out of order, and causes a false test to be put on a line, or else no test at all. It is possible that the next board built will have a separate circuit for the test, and although this will complicate the wiring, yet on the whole it is a change much to be desired. While the circuit of our subscriber's line through a multiple board is comparatively simple, when we have several thousand such lines to be brought within the reach of an operator it will be seen that an enormous number of wires have to be dealt with, and that a good system is needed to bring the wires into small compass and to avoid confusion. The wires must be well insulated to prevent leakage and consequent cross-talk; they must be in small space; the method of wiring should allow the jacks to be accessible in case of trouble. To accomplish this in the best way a special cable is used. It is oval in section and consists of 21 pairs of 22 wire tinned and insulated with two layers of silk, and a cotton protecting covering. The wires are sewed in the shape of a comb to fit the jacks and are soldered to the jacks away from the board on a long bench. This allows of a careful inspection of the joints. When jacks for every section have been attached, the whole is carried to the back of the board and the jacks screwed in place. A glance at the back of a board will give a better idea than any amount of description. The jacks and the wiring are the most important part of the board. The least trouble with any jack will interfere with the working of that subscriber's line, and in an exchange of several thousand, when a line passes through 20 or 30 jacks it will be seen how many chances there are for trouble, and how carefully the jacks have to be made and set up. In the switch here, the troubles in the multiple average about two a day, while the trouble from all the causes inside of office average about three to four a day.

The most fruitful place for trouble is at the point where the spring rests on the contact; a little dust lodging there will open the line or else introduce such a high resistance as to render speaking very difficult; and a great deal of ingenuity has been expended in trying to devise a board without contacts in the jacks, and we hope that the next board will have this very desirable feature. The amount of work that can be done on a multiple board is very great. In Montreal the average number of calls answered by the operators average 766, and a busy operator when pushed has answered over 1600 calls a day. At one exchange in Montreal, equipped with standard boards and accommodating about 1400 subscribers, the average number of calls answered per operator is 475, the highest being about 1200 as compared with 1600 answered on a multiple board, so that about 25% more calls should be attended to on a multiple than on a standard board. The average time for making connection in Montreal where there are four exchanges is 35". The time required for this in a single exchange should be less than this. In an exchange wired for 1500 subscribers, each line has about 70 soldered connections and 30 contacts in its circuit. Any one of these connections is a place for possible trouble of some sort. At the same time an operator may be answering two calls a minute and is liable to put a plug in a wrong jack or not to notice a busy test, so it is hardly to be wondered at if mistakes do occasionally occur though the greatest care is taken to prevent them.

On the whole as I have said before, a multiple switchboard is very satisfactory and is the best system in use to-day for exchanges of over 1000 subscribers, and though details may be altered, and we hope improved, yet the principle of this system bids fair to be the basis of the best telephone exchange equipment for some time to come.

Moved by Mr. Smith, seconded by Mr. Nicholls, that we tender Mr. Baylis a vote of thanks for the paper which we have just heard with much interest. Carried.

Mr. K. J. Dunstan then took the chair and announced that Mr. J. J. Wright would read a paper entitled "Steam and Electric Power."

STEAM AND ELECTRIC POWER.

The subject that has been allotted to me is of such a comprehensive nature that it would be impossible to do it justice within the limits of a paper that would not trespass too much on your patience to listen to. In fact this title, chosen by our worthy Vice-President, would cover the whole range of electrical business from the galvanic battery of the street corner fakir to the power plant of the Niagara Falls Tunnel Company, and in the line of steam engineering it would include the hot peanut stand and the ocean steamship. Not being able therefore, to cover such an extensive field, I will venture to offer a few suggestions on the distribution of electricity for power purposes, which I hope may prove of benefit to those of our members who may contemplate the introduction of such a system. Firstly, then, your power has to be produced, and if you wish to do an extensive business by supplying power at a reasonable rate, or if you have to meet the competition of some enterprising party who thinks you are making something and therefore wants that something for himself, you must figure to produce it at the lowest possible cost. It is scarcely necessary to state to an intelligent assembly like this, that you cannot actually create any power by means of electricity. We must leave it to the penny a line paragrapher to state as his opinion that the steam engine will be superseded by electricity, that steamers will be driven across the Atlantic by electricity, and will require no space for fuel, and so forth.

Electricity, at all events as we know it now, is simply a mode of motion or a method of transmitting power. You may call it simply an invisible line of shafting or a length of belting. Electricity is liable to the disabilities connected with these methods of distributing power, inasmuch as there is a loss by reason of distance. You may call it the friction in the wire just as you would have to reckon with the friction in the bearing of a line of shafting. To allow for the various losses in converting your power into electricity and re-converting in the shape of power again, you will always have to produce a certain percentage more than you recover. Economy in the prime mover is therefore more than ever a necessity. You are a happy man if you possess a water power within reasonable distance of a fairly good market, but it seems to me that water powers, as a rule, for some inscrutable reason, are usually located in very inaccessible places. Your line of invisible shafting becomes too long and in the end will cost you about as much as steam on the the spot. Power you must have, wind is out of the question, and water having failed, we must fall back on our old friend the steam engine. I am not going to thresh out the obsolete controversy of high speed engines versus slow speed. That question has been settled long since. Be moderate in all things. While you are avoiding the high pressure steam eating flyer on the one hand, do not go to the other extreme and build an unwieldy engine that makes one revolution to-day and another to-morrow, and, as the saying goes, carry all your eggs in one basket. Five hundred horse power is about all you should employ in a single unit but of course the size of engine will be governed very largely by the extent of the power plant you propose to install. But here let me give you a special piece of advice. If you honestly think one hundred horse power will be enough for the demand upon you, make it two hundred. If you think two hundred will suffice, make it four, and you will come out about right in the end. If you have no water for condensation, be very cautious about meddling with a compound engine. Unless the load is accurately proportioned to the size of engine, the low pressure cylinder will be a positive detriment, and it is well known that in this respect a power circuit fluctuates within very wide limits.

If water for condensation can be obtained, by all means use a compound condensing engine, but if you do so and have a good boiler and can carry at least a hundred and twenty-five pounds of steam pressure, make the diameter of the low pressure cylinder larger than the common practice, in fact nearly as large as the third cylinder would be in a triple expansion combination. I have very strong doubts whether the middle cylinder in a triple expansion engine is any good at all. It is an open question whether the slight saving of steam by the more uniform temperature of cylinder is not more than over balanced by the increased complication, weight, and friction of the extra moving parts. The reason for the existence of a triple expansion engine is that it is the outcome of a gradual evolution, first the high pressure, then the compound, then a further use of the steam to ensure the benefit of the vacuum on a very large area of piston in the final cylinder. Now drop the middle cylinder and use a large low pressure in proportion as a compound, you will get the benefit of the vacuum over the increased area, and you will find equal results will be attained with less proportionate wear and tear and risk of accident.

Now another point. If your engines are of considerable size, and a compound of the proportion spoken of would have a comparatively heavy low pressure piston, place them upright. They will take up less room, and instead of having a heavy piston of a ton or a ton and a half weight dragging along the bottom of the cylinder you have it floating in the centre. Wear and tear is reduced to a minimum and large economy in fuel and oil is the result. Let your engines move lively but at a reasonable speed, say from 85 to 90 revolutions for a 250 or 350 horse power engine, or to express it in a better form, say at about six hundred feet of piston speed per minute. If circumstances compel the use of high pressure engines, see that they are large enough to have plenty of room to take the utmost benefit from the proper expansion of the steam. An engine to be economical should not carry steam more than from one eighth to one quarter of the stroke at the outside.

Having a steam plant that we can depend on producing power at the lowest possible figure, we must turn our attention to the question of its distribution in an economical manner. This is not at all an easy problem to solve, and much will here again depend on location. The higher the pressure at which power can be distributed the greater the economy in first cost of construction and in subsequent operation, but there are two serious drawbacks to high potential, first, increased liability to derangement in the electrical apparatus, and secondly, the difficulty of building and successfully operating motors of small power. Given a certain distance to your centre of distribution, you have to strike a balance between interest on the cost of large sized copper conductors to reduce the resistance, and the extra consumption of fuel required to drive your current over small wires. I am speaking now of a system of constant potential suitable for distribution to consumers in large or small quantities, and not of the new fangled long distance alternating current exploits that require a deaths' head and cross bones painted on every pole as a gentle hint to the unwary to keep their own side of the highway. For distribution from a central station within a reasonable area, say half to three quarters of a mile in any direction, a pressure of 250 volts appears to be most suitable. Motors can be wound for current as small as a quarter of a horse power. For greater distances, a second system of five hundred volts could be utilized with advantage and at not too heavy an expenditure for copper. There are many experiments being made with a view of bringing out a power distributing system by means of alternating currents, but at pre-

sent there does not seem to be anything positive in sight that would be better than a constant potential direct current system at a pressure as low as could be consistently used taking into account distance from source of power, cost of fuel and interest on cost of copper mains for its supply.

It might be possible in very large installations or where the ground to be covered is considerable in extent, to establish a system of high tension mains to distribute an alternating current to central points and there transform it to a lower potential and utilize it to drive a motor dynamo. This would again produce a direct current at the pressure desired. Except for small powers it would seem as if the complication introduced in a method of this kind would make the power realized about as expensive as steam on the spot. The position of a pessimist in electrical matters is a somewhat risky one to take at the present day, but it does appear to me that some of the schemes proposed for long distance power transmission are a trifle outside of the limit of commercial success. The line must be drawn somewhere at a spot where the expense of maintaining costly electric apparatus and the interest on the original expenditure will about counterbalance the cost of fuel and maintenance of a steam engine. It will also be found very much cheaper to locate a factory requiring a large amount of power at the source of power itself, than incur a continual expenditure to transmit that power to a distance. As an instance, the elaborate scheme of water power which is now in course of evolution at Niagara Falls may be cited. The American scheme, however, has crystallized into action, and large works are already undertaken. The primary object is to locate consumers at the power, but incidentally it is proposed to transmit a large quantity to the City of Buffalo. Time will show to what extent this may be commercially feasible, but when the complicated nature of the operation and its cost is considered, there is room for a pretty large sized note of interrogation.

First we have the proportion of the cost of the water power to begin with, royalties, cost of rock excavation, cost and maintenance of turbine wheels and attendance. The electrical outfit must be first, low tension dynamos producing alternating current, then transformers to raise the pressure sufficiently high to overcome the twenty miles and more of conductors to the city; the cost and maintenance, and above all the protection of this twenty miles of line; then again transformers to reduce the pressure to a manageable point; low tension, alternating current motor to convert the current again into power; and finally the cost of its distribution. This expenditure will have to compete with coal at a cost for steam purposes of from a dollar to a dollar and a half per ton. Wonderful things have been done by means of electricity and this enterprise may be successfully accomplished, financially I mean. Its practicability from a scientific standpoint has been already demonstrated.

There are locations, however, in our own country, (a country, where a paternal government is doing its best according to its light to further the interests of its people by imposing a duty on fuel), and these places are at such a distance from the source of supply that freight is very costly. Here, if anywhere, will the cost of long distance power plants and their existence be justified. But the distance must not be too great or the maintenance of the insulation of the conductors and transformers will become a difficult task as an everyday business operation. Sufficient has been accomplished experimentally; it only remains for it to attain permanent success. I remember the time, and not so very many years ago, when we considered it a big thing to operate a dynamo in one room and arc lights from it in the next. In those crude and early days it was often necessary for the operator to have his eyes on both of them at the same time. Now arc light circuits of twenty miles in length are not uncommon. It may be feasible in the near future to carry high tension secondary currents for long distances in grounded tubes containing oil, and connected to transformers in metal vessels also containing oil, and so protected as to preclude the possibility of accident from contact with them. Probably after a system of this kind is perfected and installed, it will be a fine thing, but it will be more or less risky to the experimenters before the perfect system is reached. I have often thought that a cheap and effective motive power might be devised from the repeated detonation of small quantities of high class explosives in situations where the power generated would do the most good, say behind a piston as gas is exploded in the cylinder of a gas engine. The difficulty would appear to be in separating at each stroke a minute quantity of explosive without making injurious connection with the whole stock in hand. It might be made successful, but at the expense of several relays of inventors

Elaborating these high tension systems may have a similar effect on the available stock of electricians at the outset, but I have no doubt that before very long we shall become accustomed to much higher potentials in electrical matters than we now have any idea of. Now, I remember when 8 lights was the average size of an arc light dynamo and a 12 lighter a monster, and shall not readily forget when, after much consultation, it was decided to build a 16 lighter, with what amount of respect for its power we approached the task. When it was completed, it was a creation to stand off from and admire at a distance. It was merely a repetition of history. At one time a speed of ten miles an hour on the railway was considered simply as flying in the face of Divine Providence. It is unnecessary to state what the limit of prudence in this respect is considered to be now. This brings us to another development of electricity as a motor, and that is the proposed electric railroad projected between Chicago and St. Louis. We have very little information as to the methods to be adopted or the voltages to be employed. We are told, however, that the speed is to be 100 miles an hour, and that the line is to be perfectly straight. It will be necessary. If the projectors had said further that it is to be fenced in with boiler plate it might, to some extent, relieve the feelings of the farmers along the right of way. We are to have some information on the possibilities of electric railroading a little later, so I must not anticipate. The possibilities and the probabilities are rather wide apart at present. The electric tramway fills the bill to perfection for city and suburban passenger traffic, but you must admit when you see a steam locomotive handle a freight train a quarter of a mile long or so, that the electric motor has a fairly hard row to how before it will take possession of a trunk line of railroad.

We have said nothing about the primary battery in this question of electric power. The consumption of fuel, usually zinc and acid, is so much greater and more costly than in the case of the steam engine that excepting for very small outputs, its use is out of the question. Even for the small quantities used for the purposes of the telegraph companies, dynamos driven by steam or electric motors are rapidly being adopted. The storage battery also, while having its own particular uses on a small scale, is being universally abandoned where large powers are in question. An exhibition of the transmission of power by electricity on the smallest and most minute scale is to be found in the operation of the telephone. The prime mover in the exemplification of transmission is the wave in the air produced by the human voice. The minute current induced by this motion, almost too small to be measured, after passing in some cases through hundreds of miles of wire, has still sufficient power to move the diaphram of the receiving telephone and reproduce the original sound. Electricity is a subtle power. Its wonderful adaptability to the varied purposes of life is seen in this contrast. The same invisible power may be set in motion by an infant's whisper, or a steam engine of many thousand horse power. It is the same wonderful development of physical force whether it is heard in the well known tones of the voice of an absent friend or accompanied by the thunderous crashing of heaven's artillery. It may carry a message of love, or life, or death, across the ocean with a movement as light and noiseless as the footfall of the seraphim, or do the mighty work of the world in travel, or manufacture, or mechanical force, with the power of a thousand giants' hands.

Mr. Hunt moved a vote of thanks to Mr. Wright for the thoroughly enjoyable paper he had submitted to the meeting. Carried.

Mr. Campbell: In regard to the transmission of power, apparently Mr. Wright is in favor of slow running engines.

The President: It seems to me that the medium speed appears to be the most successful and most permanent. Build large engines and get them to move lively, and by so doing you get the maximum of economy. Mr. W. A. Johnson, will now read a paper on "Possibilities of Electric Railroading."

POSSIBILITIES OF ELECTRIC RAILROADING.

The last ten years have seen great changes. We recall to memory, that in 1883, the company with which the writer is still connected, placed in operation in a rather crude and temporary manner, the first electric railroad ever operated in the Dominion of Canada. This road was constructed on the grounds of the Industrial Exhibition Association of Toronto. The electric machinery and car were hastily placed. The electric generators were two-six arc light 14 ampere Ball dynamos of the type first designed. The motor was a similar arc dynamo, and was placed on an ordinary railroad flat car and connected with car axle by a belt. One rail took the place of the modern trolley wire and the other rail formed the return circuit.

Upon the first trial of the car everything moved off in good style, the apparatus working well. The flat car was loaded with all the people that could get on, and notwithstanding the small power of the motor it ran at very fair speed. Unfortunately, however, before the opening of the Exhibition, the officers of the Association added so much extra weight to the car by building an awning and placing seats and iron railings, together with locomotive head-lights, etc., that the motor was overloaded and the car came to a stand still when going up the grade. The trial was sufficient however, to give an idea of what could be done with electric power. The following year, 1884, Mr. Van Depœl equipped the same road with apparatus designed on purpose for the work and erected the first trolley wire in the Dominion. The road was operated with more or less success for several years following. These experiments served their purpose in directing attention to the great possibilities of electric railroading. It only remained for the electric manufacturing companies to design apparatus properly constructed, mechanically as well as electrically—such as would be able to stand the great wear and tear inseparable from such work.

Machinery is now manufactured by several well known companies that is adapted to operate street railroads and tramways with economy. Electric railroad construction and the apparatus now being used in connection, has, in all probability, reached its final stage or style of design as far as relates to efficiency and general utility. The trolley will undoubtedly remain in full sway, with possible exceptions, however, for short lengths of roads in the very largest cities, where first cost is sometimes a secondary object. Generators operated at a pressure of about 500 volts will undoubtedly continue in use for supplying current for city street service. With many others I confidently expect in the near future that a great many steam roads will adopt electric motors. Several short roads have already been equipped and are quite effective as feeders and connecting links to trunk lines. The enormous total horse power generated by the steam boilers of the locomotives now in use would, if concentrated in large units and located at stations situated at convenient points along the main line, prove extremely effective

when used in connection with electric power. There are many fine water powers in all parts of the country that can also be utilized for this purpose. About the time the trunk line roads begin to think seriously of equipping electrically they will be inclined to take into careful consideration the great cost of copper for feeders and trolley lines necessary on 500 volt circuits. Higher pressures, at least for feeders to the trolley lines, are bound to come. The recent experiments with alternating and multiphase high frequency currents have lately attracted much attention and great results are expected from he practical tests that have been and are still being made in the transmission of large amounts of power by these methods.

The changes that have followed one upon another in the last ten years in all electrical industries seem to indicate that much more is possible in this direction; as instance the evolution from the double reduction to the single, then to gearless motor. Call to mind the great number of successfull electric roads now in operation, compare the steam locomotives of the past, using gears, and the present fast mail flyers; all this indicates progress. The double reduction and single geared motors are particularly adapted for short hauls, where traffic is heavy as in city streets. The gearless motor can probably not be excelled for high speeds and long distance traffic to which it is particularly adapted, as with high speeds it is advisable to keep the armature revolutions as low as possible and the greater weight necessary will be of service in securing traction. Connecting rods can no doubt be used with advantage between the drives of motor cars for through lines, same as are at present used on locomotives. Steam railroad companies, who equip with a proper electric motor system in conjunction with electric bloek signaling and the lighting of both track and trains, (current being obtained for all from the same source of power), will have available at all times all power along the line whether from steam plants or the numerous water powers, of wh.ch there are many in all parts of the country. The railroad companies will be most decidedly convinced of the beauties of electric service as soon as adopted, and can then render much better service with less annoyance to the puolic, as trains can run equally as fast and in many cases faster than at present; more frequent service could be given by using shorter trains and more of them.

In connection with this subject of long distance railroading, the new and very interesting progress now being made in the use of alternating currents, it seems to me we should not lose sight of the well known direct (series) current. There are already manufactured generators giving 5,000 volts at 8 to 10 amperes; these can be safely coupled together to give pressure of from 10,000 to 30,000 volts, and without danger of injury to the insulation of any of the generators. The generators of most all the arc stations in Canada can thus be utilized if need be, either for new lines of tramways between adjacent towns, mines, etc., or for helping out the trunk lines. The question arises however, how is this to be done? I am indebted to Mr. Royal E. Ball for some suggestions in reference to this question, which he set forth in a letter to me written in 1891. Right here I might say that our company had on exhibition at the Franklin Institute Electrical Exhibition held at Philadelphia, Pa., in 1884, a regenerating motor dynamo, or as it may be called, a constant current transformer. This machine has been lately perfected by making it automatic, so that it can be located anywhere on a serious high tension circuit or as many of them as may be required, whether for power or for lighting purposes or both. They can be wound for any potential, 500 or 1,000 volts or over.

For long distance railroading, the current can be obtained from any generating station (within say 50 miles) from automatic arc dynamos, using for a circuit comparatively small sized wires and pressure varying according to distance. With an automatic series wound dynamo at the power station and with corresponding automatic motor at the sub station, we have a simple and economic method of long distance transmission of power whether for railroad or stationary motors or for lighting purposes. The regenerator wound to deliver required pressure for trolley line can be located at convenient stations along the line. The machines will consist in a dynamo having an incandescent armature on one end and an arc armature with its regulator on the other. The direction of rotation to be reversed from that of regular arc practice (this is so that the arc or motor armature may cut down in the proper way for motors, i. e., in direction opposite to rotation without having to alter position of movement regulator). Field to be shunt of the low tension armature. Arc armature to be in circuit with source of supply. The field (or at least that part on the arc end) comes from the low tension armature and is dependent for its strength upon the speed of machine, and that this field depending on speed, operates the brushes of the arc armature so as to make it run faster or slower according as field changes. It will be seen that this arrangement must keep field and potential for the low tension armature constant, while the position of brushes on arc vary to meet the load. With water power at one end with automatic dynamo, and with corresponding automatic motor at the other end, you have the problem solved of long distance transmission of power. The field of your motors to be fed from small generators belted from motor so that its speed depends on speed of motor. You will see that in this you have constant speed from constant current circuit. Should you wish to operate a small electric car over long distance (say up to 50 miles on each side of generating plant), it can be done in same line as above. In this case the small field generator is in the control of motor man, and he, by changing the position of brushes, changes speed, and by reversing brushes of small field generator he can change direction of car. While position of brushes of field generator remains unchanged, speed of car is constant, whether going up or down grade, if current of supply is kept constant. In short the new automatic dynamo and regenerator solves the question of series transmission of power with constant current. By a block or sectional trolley system, as many trains may be operated as wished. In this case also, a motor dynamo is to be placed in each train precisely as last referred to. Some of my hearers may think such a method a little far fetched, but it is certainly as practical and in as fully developed shape as any other methods proposed, and it would not be nearly as difficult to secure high insulation. I certainly desire as much as others to see the success of the alternating plan and the investigations and suggestions of all are necessary to reach the end in view. The field for the electric road is immense, and if the apparatus of the present central stations can be utilized, so much the better for them.

Within the last few days Dr. Wellington Adams has brought out his scheme for an electric railroad between St. Louis and Chicago, 250 odd miles; this is a move in the right direction. Railroad corporations cannot be led to take notice of the electric system until they find their custom disappearing, which very quickly brings them to time. Some of the short lines of steam roads already equipped electrically have been forced to do so through *competing* electric lines. The electric system for through railroads, once it gets a start, will without doubt cause the removal of most of the present locomotives within the next 15 years, and the factors that are going to accomplish this end are high pressure, whether with direct, alternating or rotary currents and gearless motors for either system. Results will be safety to passengers and train men, also saving of much time in transit, as 80 to 100 miles will be easy work, due care being taken to keep the train on the track or we shall have a flying machine before we are aware of it.

Mr. Thomson: I would just like to ask Mr. Johnson if he is not mistaken about the originator of the electric railway in Canada. I understood it was Mr. Van DePoele who made the first successful experiment in operating an electric railwa in Canada.

The President: Mr. Van DePoele was the first successful operator of the electric railway in Canada. He was the inventor of the trolley system. The Ball machine was placed on the track at the Industrial Exposition in 1883 and it ran down hill and it would run no other way. This is the true position of affairs.

Mr. Johnson: I have possibly made a mistake in making that statement. I have it on the best authority that the Ball car operated: but I only mention this as showing one of the first experiments of electric railroading which was brought to the notice of the public in Canada, not representing it as a success, although I think it served its purpose.

Moved by Mr. Dunstan, that a vote of thanks be tendered to Mr. Johnson for his valuable paper. Carried.

The President: We will now hear the Report of the Committee on the Revision of the Constitution and By-Laws.

Mr. Whiting: Regarding the privilege of members speaking twice on a subject, I think that while the By-laws are being revised it would be well to take that into consideration. It would be a pity for a member who had spoken to a question to be debarred from speaking again, if something new were to come up in his memory. I think it would not be well to allow Parliamentary rule to interfere with free discussion.

The President: We have power to alter this if it is the wish of the Association.

Mr. Dunstan: In accordance with "Article 9" of our Constitution, I move that consent be given for the consideration of these proposed changes. Mr. Whiting seconded. Carried.

Mr. Dunstan: When will the annual meeting be if we hold a meeting in January of next year and again in September? which will be the annual meeting of 1893 when the election of officers will take place?

Mr. Johnson: In all Associations such as this, it is usual to have a fixed date for the annual convention, and then if anything turns up to prevent the holding of it on that date, the meeting can be changed until a desirable date. We should have a fixed date for the holding of our annual convention.

Mr. Dunstan: The Executive I understand have not the fixing of the date of the Convention at all. The date and place of the next Convention is fixed by this present Convention, and has already been fixed to take place in January next, in the city of Toronto. A desirable day of the month is to be chosen later. For instance, if it was to be held in September, we would want to make it fit in with the Exposition. I do not think it would be well to decide on any particular day of the month. The Executive have no power to prevent the annual meeting.

The Chairman: We will now hear from the Committee on Amendments to the Constitution and By-laws.

"Your Committee on "Revision of Constitution and By-laws" beg to submit the following

REPORT.

In Article 1. Strike out the word "named" and insert "known as," making the article read: "This organization shall be known as the Canadian Electrical Association.

Article 2. Objects—After the word "enterprise" on 5th line, add, "and for the discussion and interchange of opinion among its members," making the article read: "The objects of this Association shall be to foster and encourage the science of electricity and promote the interests of those engaged in any electrical enterprise and for the discussion and interchange of opinion among its members."

Article 3. Membership—After the word "members," strike out "the former" and insert "by the term active members it is meant." After the word "Association" in the 7th line, strike out the words "and the latter" and insert, "by the term Associate members is meant." This will make Article 3 read: "The Association shall consist of active and associate members. By the term "active members" it is meant to include all persons actively engaged in electrical business, and who shall be entitled to vote at all meetings of the Association, and by the term "associate members" is meant those interested or actively engaged in any electrical pursuit, and who shall be entitled to attend all meetings except those of the Executive, and take part in all discussions, but shall not be entitled to vote or be eligible to office. Honorary members may be elected by a two-thirds vote of the Association."

Article 4. Officers—In the third line, strike out the words "who may be one person" and insert after the word "quorum" on the 7th line, "The offices of Secretary and Treasurer may be held by one person," which makes Article 4 read: "The officers shall consist of a President, two Vice-Presidents, Secretary and Treasurer and an Executive Committee consisting of nine members, together with the President and Vice-Presidents, five of whom shall form a quorum. The offices of Secretary and Treasurer may be held by one person."

Article 5. Fees—Insert the word "annual" after the word "the" in the first line, making this Article read: "The Annual fees shall be, for Active members, $5; Associate members, $2; payable in advance."

Article 6. Election of Officers—In the 5th line, strike out the word "meeting" and insert "annual session," which will

make Article 6 read: "All officers and the Executive Committee shall be elected by ballot at a general meeting of the Association, and shall hold office until the close of the session at which their successors are elected, such successors to be elected at the first general meeting after the expiry of one year from the date of the previous election. Vacancies in office shall be filled by the Executive Committee to cover the term until the next annual meeting of the Association."

Article 7. To remain as it is.

Article 8. Voting—After the word "officers" in the 4th line insert "and these shall be limited to not more than one proxy vote to one member" making the article read: "Voting by proxy shall not be allowed at any of its Committees except for the purpose of the election of officers and these shall be limited to not more than one prozy vote to one member."

Article 9. To remain as it is.

Article 10. In the first line after the word "ten" insert the word "active" making the article read: "Ten Active members of this Association shall be a quorum, for the transaction of business."

BY-LAWS.

Section 1. To remain as it is.

Section 2. Duties of the Vice-Presidents: In the first line after the word "or" insert, "in his absence the" "The first, or in his absence the second Vice-President shall act in the absence of the President."

Sections 3, 4 and 5. To remain as they are.

Section 6. Dues—In the first line insert the word "annually" after the word "payable," making the article read: "Dues shall be payable annually on the first June in advance. Members in arrears for dues shall not exercise the privileges of membership."

Section 7. To remain as it is.

Your Committee in making this report do not by any means think that the Constitution and By-laws are what they should be, but owing to the limited time at their disposal for making the changes it was impossible to make any changes excepting those essential for the governing of the Association for the coming year. There are many points which your Committee desired to elaborate, but taking into consideration that the time for the Convention is fully taken up, and that it would be unwise to provoke any long discussions at the present time, your Committee would recommend that the President appoint a Committee of 3 or 5 who will draft for us, during the coming year, a Constitution and set of By-laws which shall in their judgment cover what is required. This Committee to make its report to the Executive Committee at least 3 months before our next annual session, and that a copy of their deliberations be sent to each of the members in circular form, by the Secretary, at least 3 months before the annual session. This will enable all members to become familiar with the proposed changes and place them in a position to discuss them fairly, intelligently nnd impartially when they are brought up for disussion and action. In the three months intervening between the sending out of the copy of their report and the annual session, Mr. Mortimer has kindly consented to allow us the use of the pages of the CANADIAN ELECTRICAL NEWS for such discussions and enquiries as the members may see fit to make. Among the changes and additions to the Constitution we would recommend for consideration, are the manner in which the place shall be selected for our annual meetings; the payment of the Executive officers' expenses when on business of the Association; the manner in which our Secretary-Treasurer shall be remunerated; the appointment of a sub or advisory board to be chosen from among members of the Executive Committee who shall act under direction of said Committee in carrying out the details of the Association business where it is not considered advisable to bring together a full meeting of the Execntive; the advisability of electing 3 members of the Executive Committee for one term, 3 for a two year term, and 3 for a three year term, and following this election that at each annual meeting only three of the Executive Committee be elected for a term of three years. This would always leave a majority of the Committee in touch with the past year's work, and might expedite the transaction of business.

We would also recommend for consideration, that the offices of President, 1st and 2nd Vice Presidents, should not be held for two terms consecutively by one person. This would not debar the said one person from eligibility of again holding one of these offices after the expiration of one term.

The Report of the Committee on the Revision of Constitution and By-laws, was accepted as read, and the afternoon session adjourned.

THE EVENING AT THE BEACH.

The evening proceedings were of a most enjoyable nature. The delegates were entertained at a luncheon at the Beach, and a large number of excursionists went down by train and boat to enjoy the music given by the Thirteenth Battalion Band. Every car of the long train that left the King street station at 8 o'clock, was filled. On arriving at the Beach, the band took up a position immediately opposite the dining hall of the Ocean House where the finest selections could be heard to the best advantage, alike by those who were on the Beach and by the merry party that gathered around the well supplied tables. The electricians and their wives, sisters and daughters—there was a fair representation of ladies—sat down at 9 o'clock, and after a few words of welcome had been said by Mr. D. Thomson, chairman, and Mr. R. Æ. Kennedy, vice-chairman, proceeded to the enjoyment of the following bill of fare:

Spiced beef.
(Current style.)
Sugar-cured ham.
(H-ampere Meater.)
Jellied tongue.
(Watt's that?)
Roast turkey.
(Electrocuted.)
Veal and ham pie.
(High resistance.)
Chicken salad.
(Served in coulombs.)
Lettuce salad.
(Low resistance.)
Rolls and butter.
(Receiver and transmitter.)
Crosse & Blackwell's pickles.
(Long-distance line.)
Lea & Perrin's sauce.
(Cabled across.)
Sliced tomatoes.
(1-1000 ampere, 100 volts.)
Sliced cucumbers.
(10 ampere at 5,000 volts.)
Charlotte russe.
(Duplex quality.)
Wine jelly.
(20 ohm relay.)
Vanilla ice cream.
(Quadruplex.)
Fancy cakes.
(97 per cent pure.)
Lady fingers.
(Mild flashes.)
Macaroons.
(Ceiling rosettes.)
Strawberries and cream.
(Circular mills.)
Bananas.
(Long arc.)
Oranges.
(Ball lightning.)
Raisins
(Pole line work.)
Nuts.
(Keyless sockets.)
Cheese.
Crackers.
(10 H. P. motor.)
Coffee,
(A burn out.)
(Porcelain cut-outs.)

The after dinner proceedings were brief but decidedly pleasant. In calling the assembly to order Chairman Thomson announced that Mr. A. B. Smith, of Toronto, had something to say.

Mr. Smith, on rising, said: A very pleasant duty has fallen to me to-night. It am sure it is a matter of congratulation that our first convention has been such a success up to date, and I think I can safely speak for the future proceedings. A great deal depends always upon the leading spirits—the brains at the head of any organization—and we have officers at our head of whom we may well be proud. This morning a movement was started to show our appreciation of our presiding officer, and so rapidly did it spread that to night I hold in my hand a handsome non magnetic gold watch, which I take pleasure in presenting to our esteemed President, Mr. J. J. Wright. (Loud applause.)

After the company had sung "For He's a Jolly Good Fellow," Mr. R. Æ. Kennedy, President of the Hamilton Electric Light and Power Company, made a few remarks, re-echoing the sentiment expressed by Mr. Smith.

Mr. Wright replied briefly. He said the convention had been a surprise to him in more ways than one. He had been surprised as well as delighted to find such a representative gathering when the convention opened, and after other surprises the great one came in the event which had just taken place. He heartily thanked the members of the Association for their appreciation of his humble efforts and for the manner in which they had shown it.

Mr. John Hunt, of London, proposed the toast of the Hamilton Electric Light and Power Company, referring to the splendid manner in which the directors had treated the delegates in throwing open their new power house to them and in helping to entertain them.

President Kennedy suitably responded.

THIRD DAY.

The last session of the Convention assembled at 10 a. m. when President Wright read the following telegram:

BUFFALO, N. Y., June 15th, 1892.

Regret can not accept your kind invitation to meet you and my Canadian friends at your dinner to-night. Please accept my best wishes for the prosperity of your Association. May you thrive like a green bay tree.

C. R. HUNTLEY.

The President: Mr. Wadland, on account of very pressing business engagements, has been unable to complete his paper and in view of this let me introduce to you Mr. A. B. Smith' Toronto, who will address you on the subject of "Safe-Wiring."'

SAFE WIRING.

In presenting the few remarks I shall make under the head of safe wiring, it is not my intention to enter into a lengthy description of what may be termed mechanically safe construction. It would be impossible to do this, as the conditions to be met in general work are so diverse. In fact it may be said that no two installations in existence are exactly alike. On a few points there are some rules that apply invariably, but I intend rather to look at it generally from a "moral" standpoint. For instance, it is well known that dampness is a mortal enemy to successful results. To guard against this, it is necessary that every man engaged in an installation, from the highest and best paid men to the mere laborer, should conscientiously do his part. I need scarcely point out to you that the interests of the electric lighting fraternity and that of the insurance companies are identical. A failure to get good results or a risk of serious loss, is a detriment to one as well as the other. I lay great stress on the importance of conscientious work by individuals rather than on the laying down of rigid rules. It is impossible to make a hard and fast rule to cover every minute detail of an installation, and therefore without this dependence on the honesty of the workman very little in the way of safe guards can be actually accomplished. Safe wiring is more a matter of men and material than of method.

I know of no business on the face of the earth where the public and the insurance companies have to depend more on the individual reliability of the workmen than on this one. On account of the immediate concealment of work almost before it is completed, opportunities to do negligent work are

abundantly offered, so that it requires more than ordinary conscientiousness in men engaged in the work, and circumspection in its oversight.

While in a few instances much trouble and annoyance is caused by unskilled electric men, who have an idea they possess more knowledge than can be carried by one single brain, still there is a source of trouble to electric light people and the underwriters which is most serious. What I refer to is, the ignorant and clumsy interference with good wiring by plumbers, steam and gas fitters and other pipe men, and our friend the ubiquitous bell hanger. These individuals, with supreme contempt of others' rights, or through ignorance, not realizing the danger of their practices, are constantly making mischief. Nine cases out of ten, where trouble is located in an otherwise perfect piece of work, these pirates are to blame. It is a common occurrence to find gas or water pipes resting upon electric wires, these pipes or other iron work, having been placed in position after the electrical work has been completed. Furthermore, there is a certain class of men, especially gas fitters, who really have an idea that they do know something about electricity, and who believe that because wires are sometimes run in pipes, that it is their special vocation to do it. It is true in this as in other matters, that "A little knowledge is a dangerous thing." Unfortunately the public have no protection against these half-baked electricians, and it is against this class of work that the insurance companies have to fight their greatest battles. Serious loss has only been averted by constant and skillful supervision, and were it not so, the loss from this source would be vastly greater.

There are only one or two points in reference to construction work of general application which I would like to refer to. One of these is the use of cleat work in cellars, and other places liable to dampness, unless a sufficiently protected wire with a superior insulation to ordinary weatherproof is used; in fact I would much prefer to prohibit absolutely the use of cleats altogether in places liable to the slightest dampness.

Also a word of warning will not be out of place, against the indiscriminate use of porcelain knobs for outdoor purposes. These knobs are good and useful in their proper place, but the average lineman seems to imagine that porcelain is a panacea for all the evils that afflict a wire.

In closing, I desire to sincerely congratulate the members of the Association on the cordial relations now existing between the underwriters and the electrical fraternity. The future maintenance of this happy condition remains in your keeping. By employing none but thoroughly reliable men and using good materials, the present insignificant percentage of loss by fires of electric origin will be rendered still less.

Mr. Burran: Mr. Smith seems to think that the greatest trouble in the matter of safe-wiring, is in the men doing the work, and perhaps he is about right. Could there not be some scheme started to have the workmen pass an examination and certifying their ability to work properly, such as the engineers have. I think this is a thing which this Association might take up.

Mr. Kammerer: I think it would be a good idea for the Association to have these men pass an examination to see that they are thoroughly competent, and let every competent man be given a certificate. It would be a good thing for the central station people. They would then be guaranteed that the men they employed were capable of doing the work. And another thing in regard to wiring which I think Mr. Smith has gone into, and that is central station work. Too much care cannot be taken to have fire-proof switch-boards, and we cannot be too careful to have good insulation at all points. It costs a little more to put up insulated wire than naked wire, but makes a much better job.

Mr. Dunstan: I think, Mr. Chairman, that a great deal of the insulation that is used is not much better than no insulation at all. People get the idea that because insulation is used there is no danger, but they are mistaken; and I think that this Association should impress upon people that it is a wise policy to spend money for the very best material that can be obtained.

The President: Would a resolution appointing a Committee to investigate the matter meet your views? said Committee to pronounce on the advisability of putting employees through an examination on something like the same basis as the Canadian Association of Stationary Engineers. The Committee of course, would formulate some idea and report to the next meeting of the Association. Yet there is another point which should be considered: the Legislature is proposing a measure that nearly covers the same thing, and if we took any steps in the matter just now, it would look as if we were in a measure playing into their hands.

Mr. Dunstan: It is a matter which would have to be dealt with very carefully. We would have to have a copy of the Bill, to see the exact wording, as we would have to know just where we differ in its construction and draw a distinction between what we purpose to do and what they purpose to do.

Mr. Burran: What our President suggests is for the Committee to consider the advisability of the scheme, not to bring it into force.

Mr. Kammerer: It would be better to leave the matter in the hands of the Executive.

Mr. A. T. Smith: Is it the intention of this Committee to take into consideration the telephone linemen as well as the electric light linemen. We require safe wiring in the telephone business as well as the electric light.

The President: It is left in the hands of the Executive Committee to deal with it as they may see fit.

Mr. Dunstan: Yesterday I voted against the resolution fixing the standard, on the ground that this Canadian Electrical Association had to deal with all the different branches of electricity, telegraph, telephone, electric light, etc. It was hardly in a position to deal with all the different branches of electric light alone. Or if a matter comes up in connection with the telephone business, which we considered and decided upon, I would not like to have it go before the country as the decision of the Canadian Electrical Association. When those matters come up which are thoroughly of a sectional character, they should be decided by those members of the Association interested in that particular line, who might form a section. For instance, if a question in connection with electric lighting is decided it would go out as the verdict of the Electric Light Section of the Canadian Electrical Association, and not of the whole Association, where a great many of the members know perhaps nothing about electric lighting. The same with the telephones and telegraph. I think we will have to face this question before we take any steps either in fixing a standard or about safe-wiring.

Mr. Burran: I think in a case like this, we should have an examination which would cover both points. A good telephone man should understand electric light wiring, and a good Electric Light man should find no difficulty in putting up telephone wire.

Mr. Dunstan: We must not forget that we have no power to say that this man has to pass an examination on this subject. We have to go to the Legislature, and I think we should leave this matter for the Executive Committee to consider. The difference between wiring for telephone purposes and wiring for electric light purposes is very great, and our opinions are not yet sufficiently formed to know exactly what is wanted. Let this be one of the things to be brought up later on.

The President: I think myself, that Mr. Campbell's idea would be impracticable. There are a large number of men who are perfectly skilled in electric light wiring and I think it would be hardly fair to debar them from working because they did not understand putting in a telephone. I think, therefore, with the vice-president, that this business had better be left alone at present.

Mr. Dickinson: There does not seem to me, to be a great deal of difference between the two wirings. Take the outside construction work, electric light wires are run very similarly to telephone wires, and a man to be thoroughly competent should understand both methods of wiring.

Mr. Dunstan: You would not have a telephone man know at exactly what gauge the wire should be for an electric light current. I might mention that if Sections are formed, the electric light Section might take up matters of this kind for electric light purposes, and the same for the telephone, but these two branches should not be included in the same examination. If we form Sections they can be taken up separately.

Mr. Dickinson: I quite agree with you in that respect, and I would have the electric light portion particularly pass a very strict examination.

Mr. Whiting: It appears to me that if there is to be a Section at all, the Section should be to divide the men, one part of the men to do all inside wiring and the other part of the men to do all outside wiring. They should all pass the same examination as regards the relative position of the line wires.

Mr. Campbell: I think the matter has been discussed long enough, and we had better leave it to the Executive to consider.

Mr. Thomson: I move a vote of thanks be tendered to Mr. Smith by the convention, for his interesting paper. Carried.

The Vice-President, K. J. Dunstan, then took the chair.

Mr. Dunstan: I will now ask Mr. Wright, our President, to read a paper prepared by Mr. Parker, of Owen Sound. Mr. Parker has been unable to be with us, but has sent his paper to be read by Mr. Wright.

FINANCIAL ASPECTS OF ELECTRIC LIGHTING.

It is true that the science of electricity as applied to electric lighting may be said to be yet in its infancy. We must however acknowledge, that as an infant, it has early assumed wonderful proportions, an infant whose energies have been rapidly developed, and practically applied to the creation of light.

A dozen years ago, I question if there was more than one installation in Canada and not many in the United States. To-day, how changed! Hundreds of plants costing millions of dollars have been installed in the great Republic to the south of us, and our own Canada has employed this brilliant illuminant in all of its cities, most of its towns, and many of its villages.

The new world may be said to have completely distanced the old, in its method of street lighting. Germany, France, and Switzerland (which I had the pleasure of visiting last summer) have employed the system of arc lighting to some extent in their public places and on a few of their streets. Great Britain has been slow to move in the matter of arc lighting. London, while adhering to its murky gas for its streets, is rapidly introducing incandescent lighting for its shops and public buildings.

It is extremely gratifying to look back and realize in how short a time we have emerged from Egyptian darkness into a light equalling Luna's softest rays, and coping with the brilliant mid-day sun; at the same time the question will naturally present itself, does it pay as a commercial investment? do the parties who have invested their millions in giving the public this brilliant illuminant receive an adequate return for such investments? I am afraid the results prove otherwise. Mistakes were undoubtedly made and money foolishly squandered in the initiation of many plants, which if the work had to be done over again to-day, would not be repeated; at the same time, even with the knowledge that experience has taught us, are we realizing or can we realise, at present prices, the golden harvest which the manufacturer, or rather his agent, pictured in such glowing colors? Such has not been my experience, and desiring to ascertain how my brethren in other parts of the country had fared, I, a few months ago, addressed to them certain questions from which I gathered that out of 25 stations with a capital of about one million dollars, fourteen of them had paid dividends (in many instances not until the third year) of from 4% to 8%, while the remaining eleven had not paid one cent of a dividend and some of them had not met expenses. Of these 25 plants, 13 with a capital of over $700,000 were using steam as their motive power, of which only five paid any dividend. Three were run partly by water and partly by steam, of which two paid a dividend; nine were run by water, and eight of them paid dividends. From these returns I gathered that out of a capital of nearly one million dollars, dividends had been declared on only about $400,000, while the investors of the remaining $600,000 had not received one cent of interest for their money, and this state of things had existed from one to three years. In analyzing these returns I found that the small plants run by steam paying a dividend were getting for their arc lights (of from 1,200 to 2,000 c.p.) twenty five cents for midnight, and about forty cents per all night lights, while the plants run by water power could declare a profit on prices ranging from 10% to 12½% less.

More recently my friend, Mr. Yule, of Guelph, made similar results. He found that out of 52 stations only 30 were paying any dividend, of which 15 were associated with other businesses, carried on during the day, and the

lamps shut off at midnight ; the remaining 22 were not realizing any profit, and some were eating up their capital. Of the 30 dividend paying ones,

Seven were using a 9 to 10 ampere current.
25 " " 8 " "
1 " " 6 " "
7 " " 4 " "

Of the 22 profitless plants,

Four were using a 9 to 10 ampere current,
11 " " 8 " "
4 " " 6 " "
3 " " 4 " "

Appended to some of the enquiry sheets were replies not very complimentary to electric lighting as a profitable investment. One person who had been running a steam plant of 29 lights (8 amp) at 35 cents per night for 300 all nights in the year, says in answer to the question, was it a paying investment, " No—electric light apparatus cost too much, more than double what it is worth. There's no money for the central station man in it." Another with water power plant at 22 lights to 1.30 am. of 284 nights, at $64 per year, says, " No—if we had our money out of the concern some one else could run it." Another rather laconically says, " No—never knew of any plant making money ; expenses, depreciation in plant, etc., consume the whole returns. Sell gas at $1.50 to $2 per M , and short circuit your electric light plant." Similar remarks were made by many more of the 52 who answered the questions, so much so that I am led to the conclusion that to many who have engaged in the electric light business it has not proved the Eldorado which their imagination so fondly pictured. Such a state of affairs is unfortunate; surely a remedy can be found.

It is quite evident that the price received for the quality and quantity of light supplied is entirely inadequate to the outlay necessary for the production of such light, and the sooner this is understood by municipal corporations and others requiring the lights, the sooner will the business of electric lighting be placed on a sound commercial basis. While discountenancing any attempt at forming monopolies, still I think the time has arrived when there should be a closer union of the central station men as well as the manufacturers, whereby the senseless and ruinous competition so frequently engaged in, may be avoided, and contracts obtained at a fair remuneration. In cities using large numbers of lights and employing the plants 365 nights in the year, the present prices may afford fair profits, but not enough, I am afraid, to provide a sinking fund to meet the necessary depreciation in plant. A field is, however, opening up for city plants which is not available to those situated in small towns and villages. The development of the transmission of electricity for power has within the last few years made considerable progress, and its use may fairly be counted upon in the near future in displacing horse power on street railways, and the motor run by electric light plants during the day may find employment in a thousand and one places where hitherto steam, horse or man power has been employed.

These advantages do not, however, and will not for years to come, extend to our town and village plants. Here we find installations of from 15 to 30 arc lamps operated by steam power, running to midnight, and employed not probably more than an average of *six hours* out of twenty-four and only getting from 15c. to 20c. per lamp per night for 300 nights in the year.

It does not require the wisdom of a Solomon to recognize the fact that no dividends can be expected in such cases, and that it is only a matter of time and a very short time at that, when either better prices must be obtained or the plants shut down.

Even in the neighbouring republic, where much better prices are obtained, we find that as a commercial investment it has not met with that success which would warrant capitalists in again investing in like enterprises.

Mr. Wiman in his paper read before the Buffalo Convention of the National Electric Light Association of the United States, quotes as follows from a western correspondent :

"I am the president and manager of five electric light companies, but three of which have actually survived financial pressure and bankruptcy. One of these three with a capital of $150,000 fell behind nearly $100,000 in seven years, and last year the stock holders voluntarily came up with an assessment of $60,000 to save it from bankruptcy. Another, working under the strictest economy, is but barely able to meet operating expenses. The other paying no salary to its executive officers, after 18 months operation declared a dividend of 3%." The same correspondent pertinently remarks, "books can be kept so as to show an earning, but this in many cases at the expense of a constantly depreciating capital investment."

From this, and similar information, I gather that our electric light brethren in the States, even with big prices, are not doing a great deal better in the way of paying dividends than we in Canada are.

I submit a few of the prices obtained on the other side, from an excellent table prepared early in 1892, by Mr. Chas. Baillairgè, Engineer of the City of Quebec. The prices are reduced to the basis of all night, and every night in the year.

Name of City.	No. of Lights.	Price Per Night.
Albany, N. Y.	600	43c.
Boston, Mass.	1125	40c.
Buffalo, N. Y.	1700	40c.
Detroit, Mich.	827	38½c.
Milwaukee, Wis.	650	31¼c.
Minneapolis, Minn.	500	48½c.
New Orleans,	75	54¾c.
New York, several companies, about	2000	40 to 60c.
Philadelphia, several companies, about	1560	30 to 55c.
Rochester, N. Y.	1274	27c.
San Francisco, Cal.	125	$1.10
Syracuse, N. Y.	522	30c.
Washington, D. C.	206	61 1/5c.

The following prices of Canadian plants, I selected from the answers I received to enquires made :

Cities and Towns.	No. Lamps.	Price Per Night reduced to a basis of all night and 365 nights.
Brockville	29	35c.
Brantford	29	28¾c.
Belleville	41	28¾c.
Chatham	49	33c.
Hamilton	310	28c.
Kingston	—	28c.
London	275	28½c.
Ottawa	300	30c.
Owen Sound	30	24⅔c.
Quebec	308	22c.
Sherbrooke	52	34c.
St. Catharines	62	30c.
St. John, N. B.	220	25½c.
St. John, Nfd.	43	42⅔c.
St. Thomas	29	28c.
Toronto	900 to 1,000	29¾c.
Winnipeg	100	75c.

While not desiring to be considered a pessimist in the matter of electric lighting, I think that the most sanguine will acknowledge that the present condition of affairs cannot last for any length of time. A remedy must be found either in better prices or less cost. The sooner this remedy is found and applied the better for those whose capital is locked up in this business. We ask no bonanza, but we do contend that capital invested in electric lighting should be as profitable as that employed in other legitimate enterprises. I have very imperfectly brought this important matter before the convention, but I trust that, however imperfect my work may be, it will be the means of provoking discussion from those who have given the subject greater thought and time than I have, and who may be able to throw out suggestions which may prove valuable to those struggling under " no dividends." In conclusion, we may I think be permitted to gather consolation from the concluding remarks of Professor J. Houston, who in a lecture recently delivered before the Department of Electricity, at Brooklyn, N. Y., says : "I know how dangerous it is, even under the most favorable circumstances, to assume the position of a prophet, yet I desire to venture a few suggestions concerning what seems to me electric science has in store for the human race in the near future."

1. A cheaper means for the production of electricity than is now obtainable by burning coal for the purpose of driving a steam engine, which on its part turns a dynamo electric machine. This invention will probably be found in some improvement in thermo-electricity, whereby coal will be burnt directly to produce electricity, and not through the double intervention of the steam engine and dynamo.

2. The entire replacement of the steam engine by the electric motor.

* * *

3. The replacing of the electric light of to-day, with its preponderance of useless and injurious heat energy, by some means of electrically produced light, which shall possess a smaller proportion of the useless heat rays and a larger proportion of light rays. * * *

Mr. Dunstan : I am sure that paper should produce some discussion by electric light men.

Mr. Campbell : It is the greatest wonder to me, how these small electric light plants pay expenses. If they ran the electric light business the same as any other business, no doubt they would make money. The best Gas Company in the world cannot do free piping. You go into a city where you have to do free house wiring and it is an utter impossibility to make money. If these electric light men would do as gas companies do, take it to the door and make the user pay the rest, there might be more money made.

Mr. Thomson : I think Mr. Campbell's experience must have been in a town or city where no gas is in existence. He will find if he wants to do electric lighting where there is a gas company, he has got to do free wiring : since we have done free wiring in Hamilton, we have added 1500 lights to our number. The gas companies do not do free piping, but why? When gas started some years ago, there was no light in use but candles, but when electric light came, it had to take second place, and there are some people who will stick to gas because it is a little bit cheaper. Of course, if you go into a city where there is no gas, you can charge for your wiring. The reason, I think that so many plants cannot pay for themselves, is mismanagement. I move that Mr. Parker be accorded a vote of thanks for the paper he so kindly contributed, seconded by Mr. Carroll. Carried.

Mr. Dunstan moved, seconded by Mr. Thomson, "That this Association pledges itself to do everything in its power to secure a large and satisfactory exhibit of Canadian manufactures of electrical plant, at the World's Fair, to be held in Chicago next year."

Mr. Dunstan : You all heard what the Commissioner said yesterday that this Association should do all in its power to aid the Commissioners in their work, by making a thoroughly satisfactory exhibit of Canadian manufactures in the electric line, at the exhibition next year.

The resolution was unanimously adopted.

Moved by Mr. Dunstan, seconded by Mr. Carroll, "That a hearty vote of thanks be tendered the Board of Trade, Hamilton, for their kindness in placing their Board room at the disposal of this Association, also to express its indebtedness to the courtesy and assistance of Mr. C. R. Smith, the Secretary of that Board." Carried.

Moved by Mr. Campbell, seconded by Mr. Thomson, "That the CANADIAN ELECTRICAL NEWS be recognized as the official organ of the Canadian Electrical Association. Carried.

Mr. Mortimer : On behalf of the CANADIAN ELECTRICAL NEWS, I beg to express my sincere thanks for this expression of regard for the paper. We will only be too glad to do all in our power to assist in any way in promoting the interests of this Association.

Mr. Black : Before the Convention closes, I would like to make a suggestion. It has occurred to me, that in large centres, like Toronto, Hamilton and Montreal, where members can be got together easily, we might have a local Association, meeting monthly or otherwise. I was astonished to find so many Hamilton men in this Association, and I think we have facilities here for a good local Association. The work of the Canadian Association would be helped in every way, and I think that those who took part in the meetings would be benefitted thereby. I believe it is a good idea to meet together and discuss matters relating to electricity.

Moved by Mr. Thomson, seconded by Mr. Carroll, that a vote of thanks of the Association be accorded the press, and particularly the Hamilton press, for the very efficient manner in which they have reported the proceedings of this Convention. Carried.

Moved by Mr. Edkins, seconded by Mr. Carroll, that the thanks of this Association be tendered the Hamilton Electric Light and Power Company, the Bell Telephone Company and the Great North Western Telegraph Company for the manner in which they have contributed towards the expenses and entertainment of the Convention. Carried.

Mr. Dunstan : Before this meeting adjourns, I will move a vote of thanks to our Secretary, Mr. Mortimer, for the time and labor he has spent on this Association. We all know that a great deal of time and trouble must necessarily follow the formation of a Society of this kind, and both of these, also the columns of the ELECTRICAL NEWS, Mr. Mortimer has kindly placed at our disposal. The paper has been a very great assistance to us. I think as the last act of this Association, we should tender to him a very hearty vote of thanks. Carried.

Mr. Mortimer : I thank you very kindly for this vote of thanks. I may say, that I feel amply repaid for anything I have done for this Association by the very satisfactory manner in which everything has passed off at this Convention. I feel that this Association is bound to be a success.

Mr. Kammerer : As there does not appear to be any more business before the convention, I move that we adjourn until next January, the day of the month to be fixed by the Executive Committee. Carried.

President : I declare this Convention adjourned, until next January.

After the close of the Convention, the delegates, accompanied by their lady friends enjoyed a drive to various points of interest in the city.

NOTES.

The Royal Electric Co. and the Eugene Phillips Electrical Works, of Montreal, occupied a parlor of the Royal, with a display of their goods.

SPARKS.

At the annual meeting of the Chaudiere Electric Light Co. the officers were re-elected.

Mr. John Langton, Superintendent of the Edison Works at Peterborough, has been succeeded by Mr. Andrews, while Mr. Fair has succeeded Col. Francis as auditor. It is reported that Mr. Langton will engage in business in Toronto as an electrical engineer.

Some prominent business men of Montreal met a few days ago, for the purpose of organizing a new telephone company. Messrs. F. X. Moisan was elected temporary chairman, and after seme discussion a board of provisional directors was elected as follows: Messrs. J. S. McDougall, Lucien Huot, J. M. Marcotte, F. X. Moisan, O. Vanier, Joseph Archambalt, C. F. Beauchemin, Edward Dagenais and H. M. Linnell, the Canadian agent of the Ed son General Electric company. It was decided to call the new company the Merchants Telephone Company, with a capital stock or $500,000 in shares of $25 each. It was also decided that the rates for telephones should not be over $25 per annum, and, if possible, less. The provisional directors will meet in the near future to organize the company and secure a charter.

TRADE NOTES.

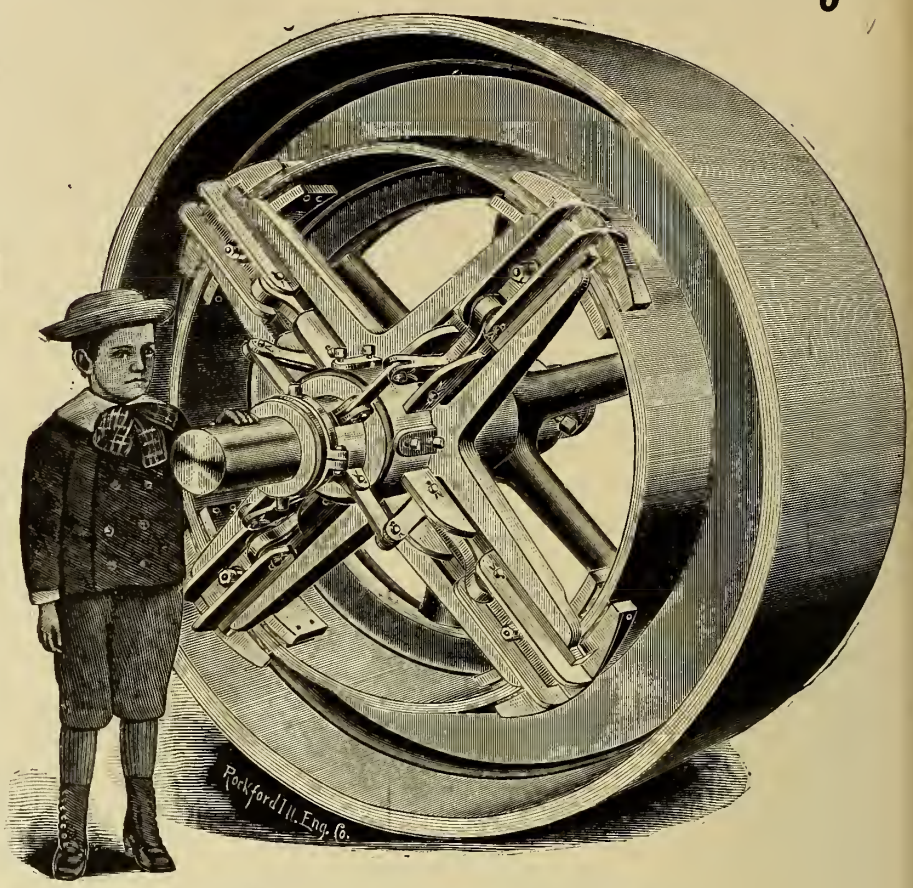
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PUBLICATIONS.

The eleventh annual issue of J. A. Berly's *Universal Electrical Directory*, for a copy of which we are indebted to the publisher, shows the rapid increase of all electrical industries and the numerous subsidiary trades connected therewith. There is an increase of 65 pages over the 1891 edition; the 1892 book contains 200 pages of new matter. The book is a very useful one to all those who are engaged as electrical and machanical engineers, manufacturers, traders, and contractors.

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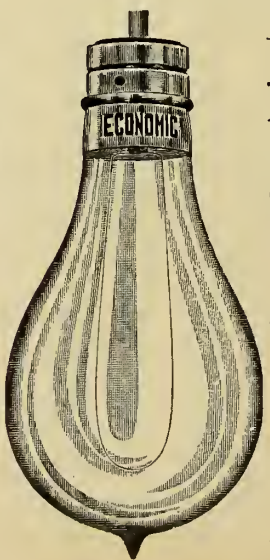
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PERSONAL.

On the 11th of June the employees of the electrical supply firm of T. W. Ness, of Montreal, presented Mr. Wm. B. Shaw, electrician, with an address and a handsomely engraved gold locket as a token of their esteem on the occasion of his retirement from the service of the firm. Mr. Shaw carries with him to his new sphere of action the best wishes of his old associates.

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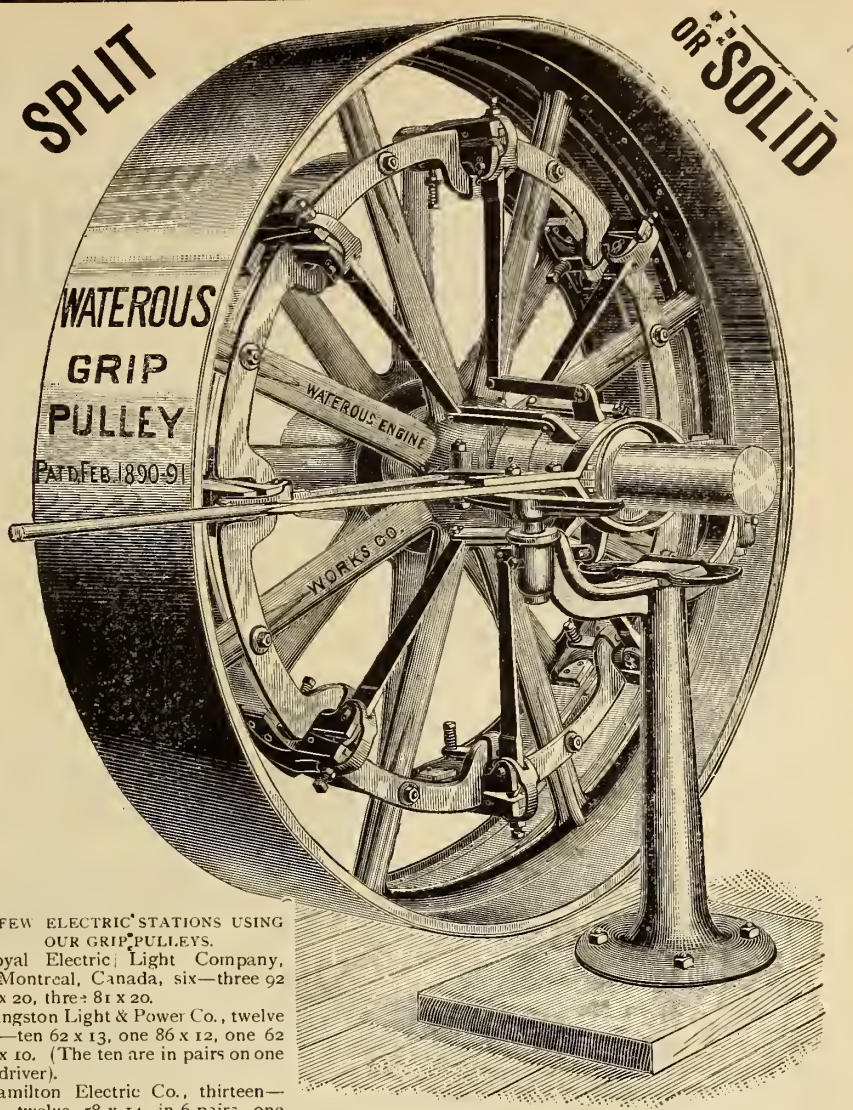
SPARKS.

The Royal Electric Co.'s new buildings now nearing completion will cost about $100,000. The Company are seeking legislation to enable them to increase their capital stock to $1,000.000.

The National Electric Light Association whose proceedings provide so many excellent papers, have as a badge the well-known formula $C=\frac{E}{R}$. In view of the Thomson-Houston-Edison combination and the proposed amalgamation of the Edison Association with the National. it is suggested that the badge now ought to be $E=\frac{T}{H}$.—*London Electrical Engineer.*

On Monday evening, June 13th, the Citizens' Telephone & Electric Co., (Ld.) of Rat Portage, Ont., held their first annual meeting, and after adopting by-laws regulating the company, proceeded to elect their directors, which resulted as follows: Messrs. Carmichael, Cameron, McCrossan, Gardner, Holmes, Rideout and McLeod. The officers are: F. Gardner, President; H. Rideout, Vice-President; A. Carmichael, Treasurer, and J. A. McCrossan, Secretary and manager. The company intend utilizing a water power of 17 feet head, situated half a mile from the centre of the town, and putting in a plant of 1500 incandescent and 30 arc lights, as well as a telephone system. The new company are meeting with every assurance of success and already have contracts for a large number of lights.

Acting on the example of the electrical fraternity in this country, the Canadian representatives of the electrical companies have formed an association and issued a call for a convention, beginning June 14th, at Hamilton. * * * It will not be restricted to any particular line of electrical work, but will, on the contrary, endeavor to embrace all. There is really no reason why this should be a difficult matter. The several branches do not naturally conflict, though the policy of some companies in this country have caused controversies within the fraternity. The Canadian association has an excellent field, and if the men who have the direction of affairs will exert themselves in extending the scope of the organization, it may do much toward advancing and protecting the electrical interests in the Dominion. It is to be hoped that the new organization will start out well, and that its promoters will be men of judgment and ability. The Canadian Electrical Association has the best wishes of the electrical interests in this country.—*Western Electrician.*



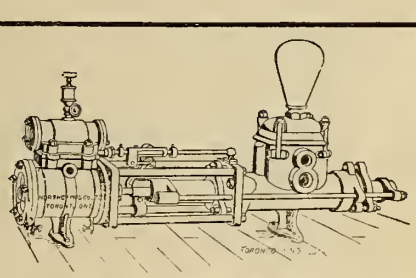
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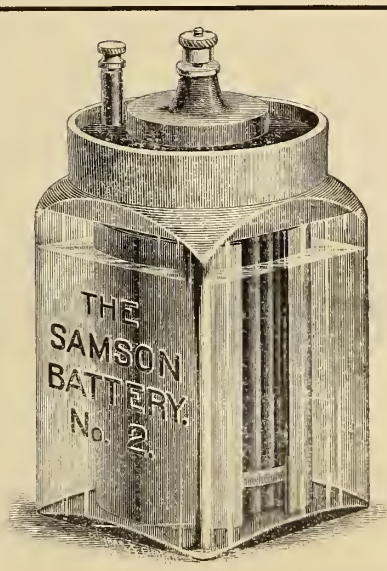
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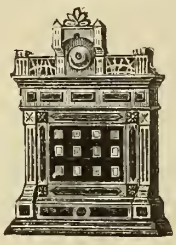
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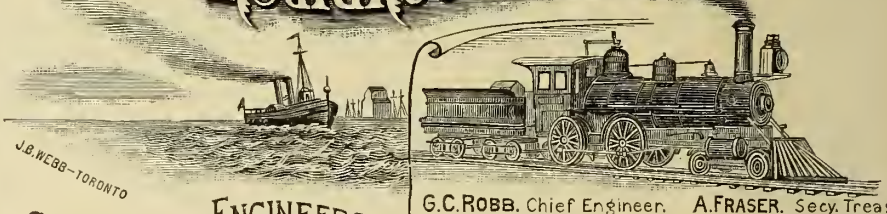
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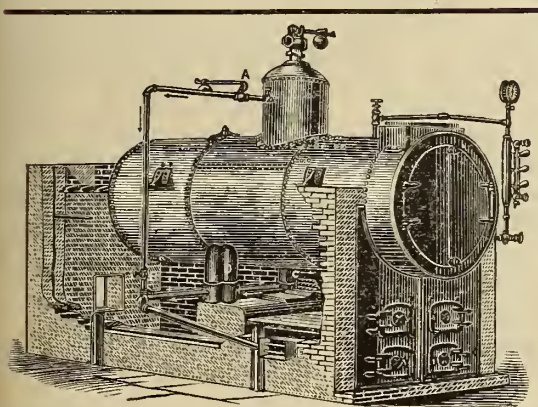
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We have the following Leather Belts in use in the works of the Toronto Electric Light Co. :—
One 36 inch belt 98 feet long.
One 36 inch belt 100 feet long.
One 36 inch belt 123 feet long.
One 38 inch belt 100 feet long.
One 24 inch belt 100 feet long.
And over 1500 feet of 8 inch belting.
All of the above belts are DOUBLE THICKNESS. The 38 inch belt is the largest belt ever made in this Province.

We are prepared to furnish belts of any size, two or three ply, up to 48 inches wide. Every belt fully guaranteed.
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THE "CORNELL-GOODE" DEVICE
FOR STEAM BOILERS AND FURNACES,
giving more economical results than are obtained by natural draught or any other system of using fuels.
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SPECIAL PULLEYS
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Our Pulley is now in use in MOST PROMINENT STATIONS throughout United States and Canada.
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INTERNATIONAL ELECTRIC CO.,

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Offers for sale and solicits orders for the following apparatus:

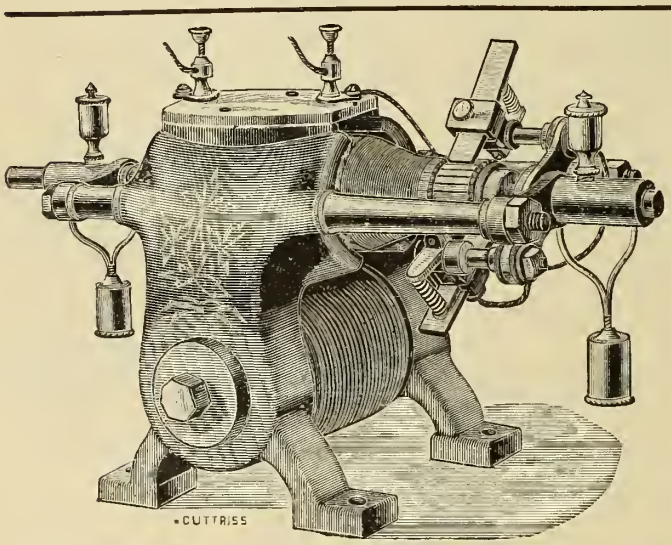
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Generators for transmission of power,
Motors, Railway Motors and Equipments,
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The above may be obtained at reasonable prices by any person requiring them, from

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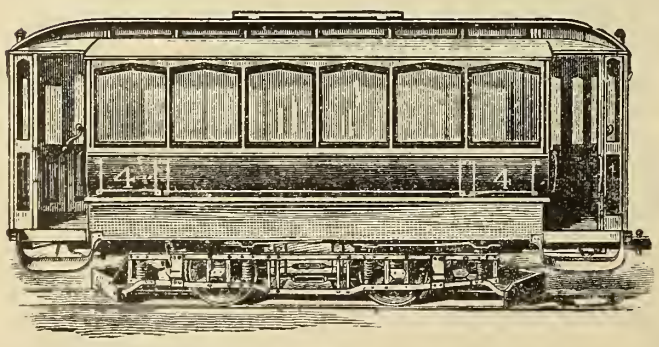
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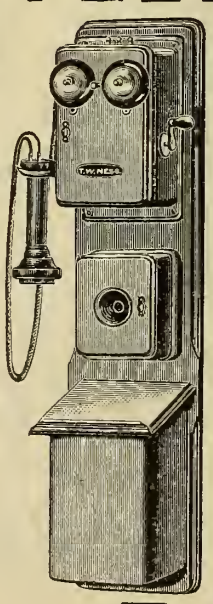


We also manufacture Horse and Trail Cars of every description.

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We manufacture Telephones for *Main Lines, Local Exchanges, and Warehouses.*

Send for catalogue, price list and testimonials.

A SAMPLE LETTER:

BRESLAU, ONT., May 10th, 1892.

T. W. NESS, ESQ., Montreal.

DEAR SIR,—I am pleased to say that the Telephone Instruments we bought from you are giving entire satisfaction. We have now twenty-nine of your instruments on our line, and they appear to work as satisfactory as the Standard Bell.

Yours truly,

ABR. S. CLEMNER.

Write us when you want anything electrical.

Key Sockets,	*Magneto Bells,*
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T. W. NESS

Canadian Headquarters for Electrical Supplies.

749 Craig Street, MONTREAL.

CANADIAN
ELECTRICAL NEWS
AND
STEAM ENGINEERING JOURNAL.

VOL. II. TORONTO AND MONTREAL, CANADA, AUGUST, 1892. NO. 8.

VANCOUVER AND NEW WESTMINSTER ELECTRIC RAILROAD.

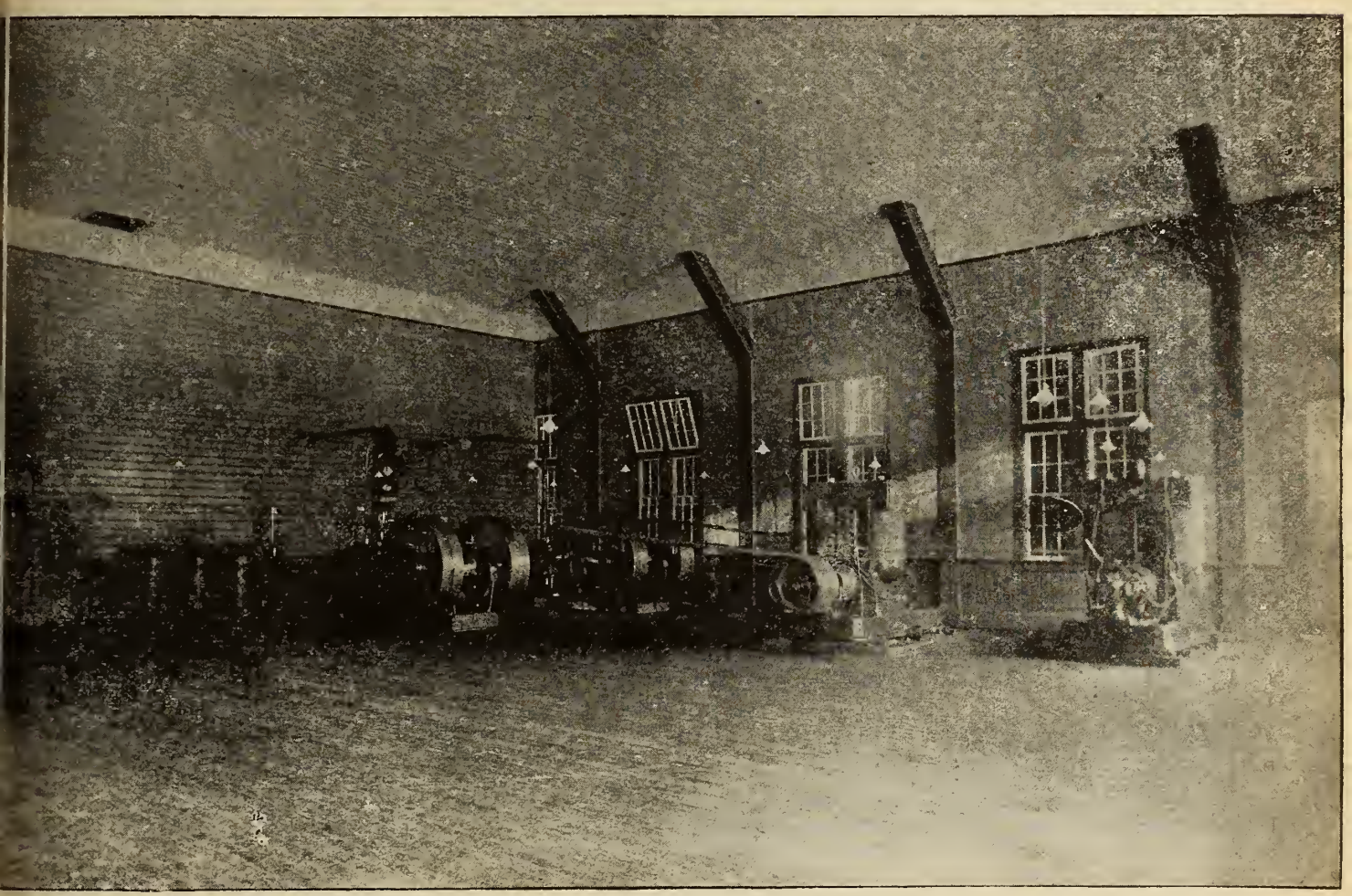
IN October of last year the Vancouver & New Westminster Electric Railroad was opened for traffic between these two cities, as well as a general service in the city of New Westminster.

The main line, which is fifteen miles long, passes through for the greater part, an immense forest of cedar and Douglas fir, which had to be cleared far enough with 8 crossings to prevent any danger from falling trees, is a single track and is laid with 40 lb. T rails, ties being laid two feet between centres. The over-head line is of the single bracket construction, except when it comes into town, when the usual double pole is used.

The road at present runs over some very hilly country and has some very quick curves, with grades of over 10% on the curves, which have a radius of 35 ft. in some cases, which makes it rather hard to operate. Notwithstanding this fact it is being very successfully operated.

The power house and car barn is situated nine miles from Vancouver, as is also a hotel for the men, and cottages for the superintendent and chief engineer. It is built entirely of wood, covered with corrugated iron; all the windows have folding shutters covered likewise, as a prevention against fire. The interior of the building, which, by the way, shows wisdom seldom seen, viz., that it is a long way too large for the present plant, is beautifully finished in pine, the floor, walls and roof being nicely stained and varnished, which makes it look in every way, a superior place and is besides, easily kept clean and in order.

The plant consists of 3 steel boilers of 80 h. p., two Leonard-Ball tandem compound engines of 125 indicated horse power each, two upright tubular heaters and two Worthington duplex pumps of ample capacity to feed the boilers and for a fire service, hose connections being fitted on. Water is supplied from three wells sunk near the boiler house, but it is intended in the near future to connect with the New Westminster water service. The foundations for the engines have unfortunately given trouble, although they are built quite massive, the soft nature of the soil upon which they were built having proved treacherous.



VANCOUVER AND NEW WESTMINSTER ELECTRIC RAILROAD POWER HOUSE.

The dynamos are from the Edison works at Peterborough, Ontario, and are of 100 kilowatt capacity at 500 volts, and are belted direct. The switch board is built up of native curly wood polished. The switches, etc., as will be seen by the illustration, are plain but neat, and all that is necessary—nothing to confuse the engineer when a break down occurs, but the opposite, so that he can see at a glance where the fault is. There is nothing so annoying to the travelling public as these waits of 5 or 10 or 15 minutes which is thus so far helped to be avoided.

Owing to the long distance and the nature of the road, feeders

are run each way, at Vancouver these cars connect with the Vancouver City cars, but in New Westminster there are three miles of very heavy road which is operated by this company.

The present car equipment consists of 4, 24 ft. Biell vestibule cars fitted with Burton electric heaters. The trucks are of the maximum traction type, and are equipped with the Edison Company's No. 12A single reduction motors, giving each caran equipment of 60 h. p., 1 passenger and freight car, combined, same as above, and 3, 18 foot cars built by Patterson & Corbin, St. Catharines, Ontario, which have the Biell no. 7 rigid truck and are equipped with the Edison Company's No. 6 double reduction motor, giving each car an equipment of 30 h. p.

The main line cars run two together every hour. At first it was meant to run only one car every two hours, but such a traffic developed almost from the start that the whole of the rolling stock had to be at once pressed into service. Even then the traffic could not be handled satisfactorily, and as a consequence at the last directors' meeting, contracts were closed for 4, 30 foot vestibule cars, two 18 foot cars, two No. 60 Edison generators, two 250 h. p. Ball engines and four 150 h. p. steel boilers. It was also agreed on to change the two present 125 h. p. Ball engines for two 150 h. p.

At the expiry of the 30 days' engine guarantee, a test was made by Mr. Angus, Mechanical Superintendent for the manufacturers, Messrs. E. Leonard & Son, London, Ontario, in presence of the Chief Engineer of the company and several of the officials, which proves the strength and efficiency of the engines for railroad work.

Seven cars were put on the road, and when on the grades a reading of ampere meter shewed 170. The voltage went down on the application of this overload to 475, but in less than 15 seconds was raised to 515 while ampere meter stood at 170. When ampere meter was at zero the voltage was 525, which shews the efficiency of the governor as the loss was less than 2%. The indicated horse power during the heavy load was 135 h. p. and at one period ran up to 140.97 as indicated by the cards taken. These engines have been running continuously for about 18 hours per day. As it was not known whether the traffic would pay for any extraordinary expense in the building of the road, it at present generally follows the general contour of the country through which it passes, but now that the traffic will warrant it, the line will be improved very considerably. Instead of going around them, heavy cuttings will be made in several small hills, long trestles will be built over the hollow spots and the heavy grades lowered.

QUESTIONS AND ANSWERS.

"A. M." writes : Send a sample copy of the NEWS, and name a good book for the study of electricity, stating price. For the purpose of learning electrical engineering, would an electric light station be a good place to start, and what would be the customary wages.

ANS.—For a list of books adapted to your requirements, see ELECTRICAL NEWS for June. An electrical manufactory would be the best place to acquire a practical knowledge of the business. The salary you would obtain would in any case not be large at the outset, and would depend somewhat upon the knowledge you possess to start with. Should an opportunity be afforded you of obtaining a situation in a manufactory of this kind, it would pay you if necessary to give your services without charge for a time in return for the information which it would be possible for you to acquire.

R. J. B. writes : I am a fireman in a stave factory. Have some knowledge of the steam engine, and have been around the electric light plant here a little. I wish to quality myself to operate an electric light plant, but cannot afford to go into a manufactory to learn the business. If I were to secure a position as fireman where an electrician and an engineer was employed, and were to pay particular attention to all that came under my notice would I be likely to get a sufficient insight into the business to enable me to operate an electric plant myself? Will you please give me a few pointers in order that I. may put myself in a position to learn the business.

ANS.—Circumstanced as you are, possibly you could not adopt a better plan than you have suggested, to become familiar with the principles of electricity and the operation ot electrical apparatus. If you could secure such a position as you mention, where you would be in association with some person competent and willing to instruct, and at the same time devoting as much time as possible to the study of suitable works on electricity, you would no doubt be able to fit yourself to take the management of an electric plant. In the June number of the ELECTRICAL NEWS you will find an editorial article giving a list of books which are considered to be most suitable for students of electricity.

"Subscriber" writes : Please give rule for finding ratio of expansion of air when applying heat. One cubic foot of air at 100° Fah., 60 lbs. pressure, absolute, how much would it expand (retaining the same pressure) if heated to 300° Fah.?

ANS.—The volume of air varies as the absolute temperature when the pressure is the same. Absolute temperatures on Fahrenheit's scale are usually reckoned from 461° below zero. 100° Fah. measured from absolute zero will then be 561° and 300° Fah. becomes 761°. The volume is increased as 761 is to 561, or one cubic foot will expand to 135 cubic feet.

M. C. G. asks: What is the lighting power of one cubic foot of carbonic acid gas as applied to a balloon ?

ANS.—Carbonic acid gas is 1½ times heavier than atmospheric air, consequently can have no lifting power unless by difference of temperature, and as carbonic acid gas is so heavy it would be much better to use warm air.

HORSE POWERS OF SINGLE LEATHER BELTS.

NO one can tell at sight what a leather belt will drive ; almost any one knowing the width, thickness, and speed, can figure it out in a minute. This table is to save figuring ; and is correct for belts 7/32 inch thick, in good condition, wrapping half way round cast iron pulleys, and joined by single leather lacings.

The rule by which it is got says "the horse power is equal to the width in inches multiplied by the speed in feet per minute and divided by 650." Thus a ten inch belt at 2000 feet a minute should be good for (10 × 2000) divided by 650, equals 30.77 horse power ; a 20 inch belt at 2500 feet, for (10 × 2500 divided by 650 equals 76.92 horse power ; and so on.

This table is for leather belts in good condition, wrapping 180° on cast iron pulleys and joined with single leather lacings :

WIDTH	BELT SPEED, FEET PER MINUTE.								
INCH'S	1000	1250	1500	1750	2000	2250	2500	2750	3000
1	1.54	1.92	2.31	2.69	3.08	3.46	3.85	4.23	4.62
2	3.08	3.85	4.62	5.38	6.15	6.92	7.69	8.46	9.23
3	4.62	5.77	6.92	8.08	9.23	10.4	11.15	12.7	13.8
4	6.20	7.70	9.20	10.8	12.3	13.8	15.4	16.9	18.4
5	7.69	9.62	11.5	13.5	15.4	17.3	19.2	21.	23.
6	9.23	11.5	13.8	16.2	18.5	21.	23.	25.	28.
8	12.3	15.4	18.5	22.	25.	28.	31.	34.	37.
10	15.4	19.2	23.	27.	31.	35.	38.	42.	46.
12	18.5	23.	28.	32.	37.	42.	46.	51.	55.
14	22.	27.	32.	38.	43.	48.	54.	59.	65.
16	25.	31.	37.	43.	49.	55.	62.	68.	74.
18	28.	34.	42.	48.	55.	62.	69.	76.	83.
20	31.	38.	46.	54.	62.	69.	77.	85.	92.
24	37.	46.	55.	65.	74.	83.	92.	101.	110.
30	46.	58.	69.	81.	92.	103.	115.	127.	138.
36	55.	69.	83.	97.	114.	125.	138.	152.	166.
48	73.	92.	111.	129.	148.	166.	185.	231.	222.
60	92.	115.	138.	161.	185.	208.	231.	254.	277.
72	113.	138.	166.	194.	227.	249.	277.	305.	332.

—Power and Transmission.

TRADE NOTES.

The Guelph Gas Co., have purchased from the Ball Electric Light Co., Ltd., of Toronto, one of their 65 light 8 ampere dynamos, to be used for all night lighting in their new station, now nearly finished. This station will be one of the finest in Canada. The Guelph Gas and Electric Co., have used the Ball system for commercial and street lighting for over 5 years.

Mr. Chas. F. Ernst, formerly with the Ball Electric Light Co., has opened a general electrical supply agency for Canada, at New Hamburg, Ont. He will represent both Canadian and American manufacturers, and has already secured the sole agency for Canada for the National and Standard Carbon companies, of Cleveland. Readers of the ELECTRICAL NEWS should be on the look-out for Mr. Ernst's announcement in the advertising pages of our next number.

The Ball Electric Light Co., Ltd., report the following sales : Guelph Gas Co., 65 light dynamo and 2,000 c. p. arc lamps ; Palmerston Electric Light Co., 500 light alternating current incandescent dynamo and outfit ; Also Ball motors have lately been sold to the following : Nasmith & Co., Restaurant, King st., Nasmith & Co., Resturant, Yonge st., A. Doig & Co., Machinists, Nelson st., Toronto ; Preston Lithographing Co., 10 h. p.; D. H. Wolfe, printer, Queen st., etc., etc.

THE "ELECTRIC."

We present our readers in this issue with an engraving of the steam yacht "Electric" owned by Mr. J. J. Wright, President of the Canadian Electrical Association. It is from a photograph taken in Oakville harbor. The boat was modelled by, and built under Mr. Wright's supervision, and intended for rough weather service. She has already proved herself to be a good and seaworthy craft. Her owner is an enthusiastic sailor, and many is the Saturday evening cruise that is made by the "Electric" to some quiet port along the lake shore or across to Niagara or Port Dalhousie. Each summer, if her owner can manage to get a week away from business, the cruise is extended as far as Kingston, by way of the Murray Canal and the beautiful Bay of Quinte. Those who are acquainted with the region around Presque Isle and South Bay will be aware of the jump of a sea that old Ontario is able to kick up on very slight provocation around those parts, and will understand that it is not always smooth sailing on such an excursion. The slight spice of adventure, however, that is pretty certain to be met with only serves to add zest to the enjoyment of the cruise, and enables the jolly crew to absorb their full share of oxygen from the lake breezes, and to return with a full stock of vigor to the serious work of life. Besides a small and serviceable dingy, the "Electric" carries a 14 ft. whale boat with air-tight compartments and double skin, and a full complement of anchors and cables, and has, moreover, sufficient canvas to enable her to make a port in good shape in the event of accident to her machinery or shortage of fuel. She is also fitted with 6 in. spent compass and binnacle, adjusted for magnetic deviation on any course. In fact nothing in her outfit has been neglected that would be necessary to meet with any condition or stress of weather likely to be met with in her wanderings.



Mr. J. J. Wright's Steam Yacht, "Electric."

WHY DYNAMOS GET HOT.

Any dynamo which is in good condition and well designed will become heated a few minutes after starting to about 170°. The cause of such heating is the loss of electricity in the machine. When ever a current passes through or along a wire, every particle of metal is set in motion, vibrating back and forth exactly as if a stick of timber were struck on one end with a hammer. In the latter case it is easily understood that the particles move in transmitting the blow. It can be seen that were the blow hard enough, particles would be drawn from each other, and the timber split in pieces.

This takes place to a certain degree, in every wire which carries a current of electricity. The blow is struck by the voltage, and the higher the voltage and the smaller the wire, the greater the vibrating effect. When the blow becomes too great, a current which is too large for such a conductor is forced through the wire. It nearly tears the atoms apart in trying to get through. It is possible to send so much current, and thereby strike so hard a blow, that the wire is heated and even melted, by the terrible commotion set up among the particles of metal.

Therefore, when a dynamo heats above 170°, it is evident that something is wrong ; either the armature is composed of wire which is too small to carry the current generated, or the armature core is not made of thin discs, or layers of iron. If these layers are thick the armature will heat worse than when they are thin. The contractor may have cheapened his work by putting in thick discs over a solid armature. The result is heating at all times. Sometimes an armature gets pretty hot through rubbing the bands against the pole pieces. No good engineer will ever let such a thing occur. He will detect the trouble as soon as the dynamo is started.

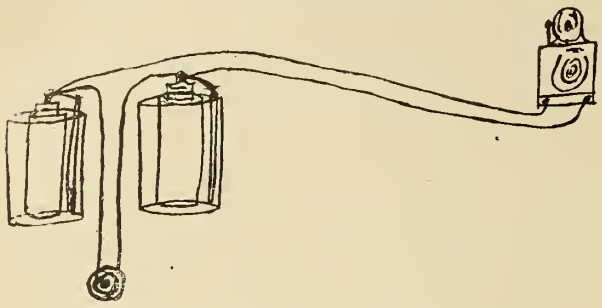
Short circuiting between two armature coils will also cause heating. This can only be detected by disconnecting each coil, and testing separately with a resistance box. This is a tool which no engineer should be without; he can construct one himself, and learn how to use it without much trouble.

A poor connection between the armature coils and the commutator may result in heating, but it surely will cause sparking at the commutator, and perhaps a flat place on one or more of of the bars. Copper, or other metallic dust, which forms a connection between two bars of the commutator, will surely cause great trouble in the dynamo. It will cause several coils to heat, and probably result in heating one or more of them so hot that the insulation will be burnt off, and the engineer left with a burned out armature on his hands.—*Flotsam.*

BERLIN, June 19th, 1892.

Editor ELECTRICAL NEWS.

DEAR SIR,—I enclose you a sketch of how a local dealer in electrical supplies was trying to get an electric bell to ring.



You will notice the zincs are "not in it" at all.

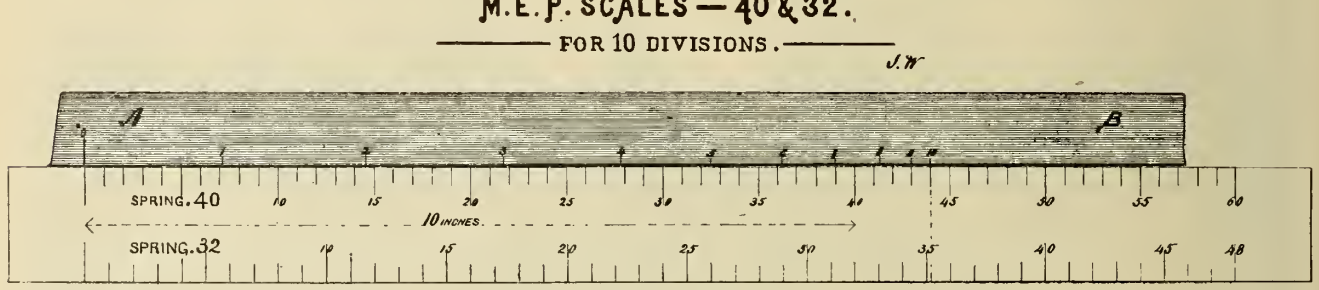
Yours truly,

H. A. ALDRICH.

MECHANICAL METHOD OF DETERMINING THEM. E. P. OF DIAGRAMS.

Editor ELECTRICAL NEWS.

SIR,—During the reading of the paper on "The Measurement of Work," before the Stationary Engineers' Association of Montreal, on the evening of March 3rd, reference was made to a mechanical method of determining the M. E. P. of diagrams. After reading the paper, the author took one of the cards on the table, marked scale 40, and determined the M. E. P. by the following process, which is illustrated by the accompanying figure:



After dividing the diagram into 10 divisions, take a strip of paper, marked A. B. in the figure, and mark on the edge with a sharp pencil or the point of a knife, the mean height of each division successively. The aggregate height of the divisions is then measured with a M. E. P. scale, on which a length of 10 inches is divided into 40 equal parts, each divisional part being then 10/40ths of an inch. By this scale the distance from 0 to 10 is 44 parts, which is the M. E. P. of the diagram. If a fraction of a division had been over, it could be read to 10ths with the scale of the spring.

On the other edge is a scale for a 32 spring, on which 10 inches is divided into 32 equal parts, each part being 10/32 of an inch. It will be observed from the dotted line on the figure, that if the diagram on hand had been taken with a 32 spring, the M. E. P. would have been 35.2 lbs.

There is an accuracy and exemption from error in this method of finding the M. E. P. of a diagram, that entitles it to be better known among engineers than it appears to be. If the diagram is divided into 12 or 14 parts, then 12 or 14 inches is the unit of the scale, and it is divided into 30, 40 or 50 equal parts, corresponding to the number of the spring. The M. E. P. is read off as before.

With 10 divisions of diagram, the M. E. P. to scales of 10,-20, 40 and 80, can be read with a foot rule, but the M. E. P. scale is preferable. With a strip of good card board 18" long by 1½" wide, an engineer can make scales to suit the springs he has or get a draughtsman to lay them out for him, and with a dividing or gird iron parallel ruler to lay off the divisions, and a strip of paper to lay off the heights, he will work up a diagram in less time, and with less labor, than with an Amstler or a Crosby Planimeter, and I will add, with less chance of error and no use for arithmetic.

Yours truly,

J. W.

THE STRATHROY ELECTRIC STATION.

Editor ELECTRICAL NEWS.

DEAR SIR,—Being in the town of Strathroy recently, I visited the Central Electric Station in that town, and for the information of your readers I submit a short description of the same. Mr. T. N. Saylor, who owns the station and plant, at once told me that I was welcome to go and come as I pleased.

The station is a white brick building 18 ft. x 75ft. and is situate just off Front street, near the Queen's hotel. Mr. Saylor came to Strathroy a few years ago and bought the lot and built a station on it, having previously bought the contract for lighting the town from the Reliance Electric Co., who had made arrangements with the town to supply the light.

The plant consists of one 25 lt., 8 amp., 2000 c. p. Reliance dynamo; one 25 lt., 4 amp., 1000 c. p. of the same make. The 8 amp. machine is used for street lighting and some private lights, while the 4 amp. machine is used exclusively for private stores for both 1000 c. p. arcs and 50 c. p. Bernstein lamps on the same circuit. The number of lamps supplied with current at present is fourteen 2000 c. p. street arcs, fifteen 1000 c. p. private arcs, and thirty 50 c. p. Bernstein lamps, which are run every night in the year till midnight.

The motive power is supplied by a 12 x 20 Wheelock engine. Steam is generated by a 54 x 15 Inglis & Sons steel boiler, with 65 3" tubes, which is fed by a plunger pump driven off the crank shaft of engine. The feed water is raised from a well by a common well pump, operated by a crank on one side of plunger pump, and is pumped into a tank from which feed pump is supplied.

The fuel consumption for this plant is ½ cord of good wood, from 7 p.m. till midnight.

Mr. Saylor has attached to the governor of his engine, a device of his own, which he has patented, and which does away with the spring on the trip rod. The resistance to the centrifugal force of governor is obtained by a dead weight and a system of levers. Mr. Saylor informed me that he could with this device throw off the load on his engine without increasing the speed one revolution.

As I seemed rather skeptical, he said if I would come around when he shut down, he would prove to me that his device would do what he claimed. It is needless to say I was on hand at the time appointed. The engine was started up light, and I counted the revolutions per minute and found them to be 76; the load was then suddenly thrown on by closing the switches, and I counted the revolutions again and found that no change had taken place. Anyone wishing further information regarding the device can obtain it from Mr. Saylor at Strathroy.

Mr. Saylor expressed himself as being well satisfied with the Reliance system. This plant is a model of its class; everything is clean and tidy from one end to the other, and is a credit to the owner, who acts as his own engineer and electrician. Any one passing through Strathroy can make sure of a hearty welcome if they wish to visit the plant, especially if they are in the business.

Yours truly,

"TRAMP."

She wasn't on the play-ground, she wasn't on the lawn,
The little one was missing and bee-time coming on.
We hunted in the garden, we peeped about to see
If sleeping under rose-tree or lilac she might be.
But nothing came in answer to all our anxious call
Until at length we hastened within the darkening hall.
And then upon the stillness there broke a silvery tone—
The darling mite was standing before the telephone,
And softly as we listened, came stealing down the stairs;
"H'lo, Central! Give me Heaven, I want to say my prayers."

—*Pick-Me-Up.*

OTTAWA ELECTRIC LIGHT COMPANY.

THE above company was organized in 1884, the officers being as follows : G. B. Pattee, President ; J. C. Brown, Sec.-Treas.; T. B. Badger, son of the City Electrician of Montreal, electrician ; W. R. Thistle, H. E. Irvine, Hiram Robinson, H. K. Egan, John Christie, Alex. McLean, first Directors. The plant was at first installed and owned by the Royal Electric Co., whose interest was purchased by the present company in 1886.

The present officers are : Robert Blackburn, President ; Senator Clemow, Vice-President and general manager ; Directors —Messrs. Blackburn, Clemow, Thos. Patterson, Samuel Howell, Allan Gilmour, James McLaren (deceased) ; Thos. C. Keefer, Alex. Spittall, Secretary-Treasurer. Mr. W. G. Bradley is the electrician in charge of the plant.

There are ten circuits leaving the station, seven for city and three for commercial lighting. There are in use in these circuits in the neighborhood of 125 miles of wire, extending to Rochesterville, New Edinburgh, the Exhibition grounds, the Experimental Farm, etc. The company supply the city with 304 street lights, the government with 26 in the government buildings, and 86 for commercial use. They have a ten years' contract with the city, which has three years yet to run. Mr. Bradley, the company's electrician, was formerly with the Royal Co. He has had charge of the plant ever since the company started.

THE TECHNICAL EDUCATION OF THE ELECTRICAL ENGINEER.*

It is impossible for many, and doubtless undesirable for the majority, to take a year from the midst of their college course for outside work. The summer vacation between the third and fourth year should, therefore, be occupied in some such employment as wiremen on electric light or telephone construction, or better, in the station and repair-room of an electric railway, under the eye of an appreciative superintendent. Three months spent in this work may seem very little, but it will do a deal of good in giving an apt student a fair idea of how far exact formulas will carry him. It is only by the generous co-operation of employers that students can obtain this summer's work. At first thought it appears that the employer gains no advantage from it, but upon careful consideration an advantage is evident. To begin with, the properly trained student will not prove useless during the summer, and the satisfactory one will usually find employment after graduation, with the interests of those who afforded him summer work, and who thus gained the benefit of his greater advancement during his last year at college. In a similar manner, the manufacturer gains an advantage from placing his apparatus in the technical school laboratories for *proper* use in instruction.

Suppose a student has completed the prescription college course, and has done a proper portion of repairing armatures, stringing wires, or similar work, at some interval between his terms at college, what shall we call him ? A few of the technical colleges of the front rank call their graduates engineers, but we have already seen that they must pass through a transition period during which the claim to the title can be proved. To call an untried graduate an engineer does not seem proper respect for himself or the successful workers in his profession. The transition period may never end for some graduates, while its length must always depend upon the man. Until the graduate has been in practical life a sufficient time to show his capacity, and has reached a position of responsibility, he has no right to claim from his college an engineer's degree. Upon this ground the University of Wisconsin, as do many others, confers degrees in engineering upon graduates of its engineering school of not less than three years' standing, who have held engineering positions of trust for at least one year. The minimum transition period is thus tacitly recognized as three years. Upon completing his college course, the student is given a graduating degree of Bachelor of Science by the engineering school, which is simply an endorsement by the university that he has received a good technical college education and is in a fair way to profit by it.

That the rigid specialization required in the technical school may not diminish the graduate's field of vision and thus his usefulness to society, is a matter of much concern. With the college left behind there is little opportunity to gain a broadening culture, except that received by contact with broad men, while we have seen how little opportunity for this can be afforded in the technical course. With this in view we recommend at the University of Wisconsin, that all who can afford the time and money complete a four-years' undergraduate course in the University School of Arts and Sciences before entering the School of Engineering. By proper elections during the general course, the studies of an engineering course can be completed in two additional years. By this plan a solid educational foundation is laid for the specialized studies of the engineering student, and the best conditions are developed for his ultimate success in professional work. The plan offers two other points of advantage : First, the student comes to his professional studies in the engineering courses with a more matured mind, which is of much importance ; second, students without the taste of hard engineering work, which is required for their future success in technical industries, will not often attempt a technical course after having completed a general course.

We can now usefully inquire into the specialized work that should be prescribed for the average electrical engineering student during his last two years at college. Up to this point students in mechanical and electrical engineering courses have received virtually the same instruction. Here, we hold, with several others, their path should diverge. The student of mechanical engineering goes into careful study of shop practice, designing and utilizing vatious types of machinery, and similar subjects. The electrical engineering student must receive a good working knowledge of the problems of the mechanical engineer, but he must, above all, be trained in the practical problems of electrical engineering. He therefore goes into a study of that which will aid most in making him truly an electrical engineer. His knowledge must all be based on mechanical laws, but he must be much more than one-tenth electrical.

Before reaching his truly professional studies, the student should gain, during his course in physics, a common-sense grasp of the elementary notions of electricity and magnetism, and of the "all-pervading law of Ohm." The latter can be properly enforced in the laboratory by placing in the student's hands ordinary electrical instruments, such as bridges, galvanometers, ampèremeters, voltmeters, etc. Before beginning his specialized work the student's knowledge of Ohm's law and its common results should have become almost instinctive.

With due regard for his preparation, it seems best to arrange the professional studies for the average electrical engineering student in four divisions, thus :

1st. Electro-magnetism and its application to practical uses, with special reference to dynamos and motors.

2nd. Electro-chemistry (including primary and secondary batteries) and electro-metallurgy.

3rd. Alternating currents and alternating-current machinery, including dynamos, converters, condensers, etc.

4th. The special application of the preceding divisions in electric light, power, railway, mining and other types of plants.

The last division is allotted about twice the amount of time given to each of the others. . . .

The student who satisfactorily completes a *proper* professional course at college, whether laid down in the college catalogue or carefully selected from that prescribed, is not likely to become one who "turns out results like a cornsheller, and never grows wiser or better tho' it grinds a thousand bushels of them." In order that he may have a fair opportunity of growing "wiser and better" in the practice of his art, he should be given reasonable encouragement. As Mr. Holley one time said, an understanding should obtain—"among the owners, directors, and commercial managers of engineering enterprises that it is not a matter of favor, but a matter of as much interest to themselves as to any class that young men of suitable ability, and of suitable preliminary culture, however acquired, should have an opportunity and encouragement to master the practical features of technical education *in works*, not as mere apprentices, but under reasonable facilities for economy of time and completeness of research. A legend on the cover of a circular lately issued by the Engineering School of the University of Wisconsin, gives the true object of the technical college, when it says, "We do not aim to produce engineers, but to produce men with great capacity for becoming engineers." If our product is accorded the treatment advised by Mr. Holley (himself an experienced manufacturer), we feel sure the work of our school and of similar technical schools will not be useless.

*Abstract of paper read at the general meeting of the American Institute of Electrical Engineers, Chicago, Ill., June 6, 7 and 8, 1892.

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NOTICE OF REMOVAL.

On or about the 20th of September next, the publication offices of the ELECTRICAL NEWS will be removed to the new Confederation Life Association Building, corner of Yonge and Richmond Streets, Toronto.

THE convention of the Canadian Association of Stationary Engineers, will be held in Hamilton, Tuesday, August 30th. All the associations will be represented, and an interesting meeting is looked forward to. The Hamilton members are making every effort to give the visitors a pleasant time. Several interesting papers will be read during the convention.

HEAT applied underneath water always makes more steam than the same quantity of heat applied over the water, or sideways. Hence in boiler setting, have the brickwork arranged so as to compel the currents of heat to pass along the bottom of the boiler, rather than along the sides. A quantity of oil was burned on the surface of a pot of water. Result, the temperature was raised one degree. The same quantity of oil was burned under the pot. Result—the water was boiled and the most of it evaporated into steam.

THE Bell Telephone Co. recently laid a cable, consisting of three pairs of stranded wires, across the Bay at Toronto from the water works dock to the crib work at Hanlan's Point on the Island, a distance of one mile. The cable, which weighed nearly six tons, and was heavily armored, was wound on a reel, the reel being placed on a scow and the scow being towed by a tug. The cable was laid in the channel which contains the intake water pipe. Considerable difficulty was met with, owing to the tug getting aground whenever it happened to get outside of this channel. The whole undertaking occupied about nine hours, although after the difficulty of getting out from land had been overcome, the bay was crossed in 35 minutes.

REPORTS from several electric lighting companies in the Dominion who have extended their plant so as to include the the supplying of power by means of electric motors, show that in some cities there is a veritable boom in that direction. One concern which we have in mind, and which has only been operating a generator for about four weeks, reports twenty motors in operation, ranging in size from one-half to fifteen horse power, all of which goes to prove what we have frequently pointed out to our readers, that there is money to be made in operating such a plant in connection with electric lighting. An editorial which we printed some two or three months ago, gave prices at which the power could be supplied to customers at a good profit to those supplying it.

IT is with pleasure we observe that abstracts from some of the papers read at the first annual convention of the Canadian Electrical Association and in some cases the entire papers have been reprinted in the leading electrical journals of the United States. This must of course be pleasant to the writers of the papers, and is a recognition that there is some electrical ability in Canada as well as in the U. S. From our own standpoint we know that some of our Canadian electricians rank just as high in the scale of electrical knowledge, as do those of our neighbors, but the fact remains, and is sometimes very apparent, that the latter are apt to think differently. There can be no doubt whatever but that the field for obtaining knowledge in electrical matters is much greater in the United States than in Canada. There is a draw-back, however, in the fact that such a large force of workmen is required to handle the amount of material turned out, that it becomes necessary to keep a man in one department only, consequently he does not get that shifting about, first at this thing and then at that, which is bound to give him a wide and varied experience and so make a more thorough and practical man of him. From this point of view at least, there is some advantage in being a Canadian.

THE question is frequently asked of electricians if a watch carried in the pocket of a person riding on an electric tramway or street car, will thereby be affected by magnetism. As this

is a question that any of our electrical readers may be called at any time to give an opinion upon, we have taken pains to propound the question to a party prominent in electrical matters in Canada. His reply is as follows : "There cannot be any doubt whatever but that the increased use of electricity, particularly in the operation of street railway cars, is bound to affect more or less the watches that are worn by the passengers; particularly is this the case where there are many steel parts about the works of the watch, such as a steel balance wheel, and steel escapement and hair springs. Perhaps the greatest amount of damage will be done when a heavily loaded car is ascending a grade, at which time the motor calls upon the trolley wire to supply it with an amount of current far in excess of what is required to propel the same vehicle on a level track and with very little load, so that the iron of the motor reaches saturation or nearly so, under which conditions there is sure to be an extending outwards from the motor as it were, of magnetic lines that must have some influence on the fine hardened steel parts of a watch, and induce destruction of its utility as a time keeper." After reading the above the question will naturally arise as to the remedy for such a state of affairs. At the present time we are only able to say, have the movement changed to a non-magnetic; true, the magnetism can be removed or neutralized in a watch affected, but it will only last as long as its owner keeps it away from the magnetic influence.

THE first city in Canada to equip its street railway so as to be entirely operated by electricity, is Hamilton, and the management of the Hamilton Street Railway Co. deserve praise for the expeditious manner in which they have made the change. The street car horse is now a thing of the past, and some 20 miles of track have the electric cars flying along them at such a rate as to make an ordinary street railway that is yet using horses green with envy, not solely on account of the increased speed attained, but also from the fact that nowat least two nickels will fall into the box for every one that fell into it when the road was operated with horses, thereby materially increasing the company's revenue, and at the same time reducing operating expenses. Statistics show that an electric road can be operated by the trolley system with the saving of at least 20 per cent. over that operated by the old slow going quadruped. Then there is another point to be considered, which is, that with a street railway operated at the speed at which an electric road can be operated, a person going in the direction of a car cannot afford to waste time enough to walk the distance when for a few pennies he can be deposited at his designation perhaps 20 or 30 minutes sooner. It increases the vim and push and energy of the people generally to have the trolley cars travelling along the streets at a "get there" pace ; they are bound to get into the way of moving energetically themselves. It gives us much pleasure to congratulate the people of Hamilton on their street railway, and it proves once again that the name of the "Ambitious City," is well chosen.

PERHAPS one of the most troublesome things that central station managers and superintendents are compelled to handle is arc light carbons. They are one of the very few things connected with the electric lighting industry that are to-day almost as they were some ten years ago, except in the matter of price. The effort seems to have been to make as good an article at a less figure, while the ingredients used and the quality of the product are as nearly identical as possible with what those existing when carbons were 12 cents apiece. It strikes us very forcibly that there is a rich field for the experimenter in this direction. There cannot be any doubt but that the best of carbons made to-day would stand a great deal of improvement. Surely a carbon should be made that would burn with a fixed amount of current, and give a steady non-flaming and noiseless arc, doing away entirely with the spluttering frequently seen in the general run of arc lights. We predict that such a carbon will be manufactured at some time in the near future. It only remains for some bright individual to find the material and hit the combination to produce this result ; of course, we are not ignorant of the fact that fully one-half of the fault that is found with carbons can be placed on the poor adjustment of the lamps in which they are used, but the other half we feel sure is clearly to be blamed on the carbons themselves. Then again, manufacturers should use the most stringent measures to produce an absolutely straight carbon, for much of the quiet burning of an arc lamp depends on this as well as on the quality. We regret that we cannot find this the case in any instance, be the carbons manufactured either in the United States or Canada, and though it may seem a bold assertion to make, yet we feel that we are not overstepping the bounds of truth when we say that there cannot be found to-day, a box of 1000 carbons of 7/16 in. in diameter that will not average more than 25 to 35 per cent. of crooks—not such as may be designated so by the manufacturers themselves, but crooks, nevertheless, simply because they are not absolutely straight. Now, the purpose of this article is not to tread on any of the manufacturers' toes, but only to point out to them in what direction they should seek to improve their goods, and thereby not only benefit themselves, but save the electric light men worry and annoyance ; its mission will be more than fulfilled if it but points the way to improvement in any one of the above mentioned directions.

THE DYNAMO.

DYNAMO and magneto-electric machines consist essentially of a coil of wire—"the armature"—rotating between the poles of a large magnet, the poles being bent round so as to approach each other and have the armature between them. This magnet may be either a permanent magnet of hard steel, or an electro-magnet consisting of wire coiled round a soft iron core, a current of electricity being made to circle round the wire coil, and thus magnetizing the iron core while it lasts. A magnet produces an influence in the neighborhood around it, and this surrounding neighborhood is known as the "field of force" of the magnet ; *i. e.*, the sphere in which its influence can be felt.

A magnetic needle or a bit of iron filing placed in this field sets itself to point along the "lines of force" of the field ; that is, the lines along which the magnetic force acts, and which form curves around the magnet, running out, as it were, from pole to pole, curving from one to the other. When a coil of wire, or armature, is made to revolve rapidly in the strong field of force which occupies the space between the poles of a powerful electro-magnet currents are produced in the coil. These currents alter their direction through the coil every time the latter changes its position with reference to the poles of the magnet. The side of the coil which was opposite the north pole is after half a revolution opposite the south pole, and the influence of the south pole tends to produce an opposite current to that of the north pole. Here we have an "alternate current" dynamo machine. As the coil, or armature, rotates with great speed some hundreds of revolutions per minute—these currents in alternating directions, succeed each other very rapidly, and if an electric arc lamp is placed on the circuit it will be lit up. In this case it is not necessary that the current be sent around the circuit in one direction only ; but although the terminals of the lamp are constantly changing their politary—that is the north pole, where the current enters, the next instant becomes the south pole, where the current leaves—yet, as this occurs many times in one second, the effects produced is the same as if the current was in one uniform direction.

In a "continuous-current" dynamo, which is necessary for some purposes, such as electro-plating, where the effect desired could not be produced if the direction of the current was continually altering, the electric current is made to pass always one way round the external circuit. This result is got by using the ingenious device of a commutator, which automatically deflects the current so as always to send it in an unvarying direction. This commutator consists simply of a split tube, which is attached to the revolving armature, and may be seen in any dynamo working on the continuous system. This tube revolves with the revolving armature, and it is divided by an insulating substance into two parts. Each half is alternately on the left and right of the space between the poles of the magnet and the "brushes" which collect the current from the armature ; *i. e.*, the bundles of copper wire spread out like a brush, which form each end of the outer circuit, are fixed in position, and the revolving commutator attached to the armature brings alternately one of its half-tubes into contact with a brush. Thus the half of the commutator which receives the current changes at the same time the direction of the current though the coils of the armature is reversed ; in this way the current sent out to the brush which receives the electric current from the armature is always in the same direction.—*Boston Journal of Commerce.*

ELECTROMOTIVE FORCE.

THE most terrifying term in the electrical vocabulary to the uninitiated and beginner is the word "potential." This word has been discussed by scientists and electricians to such an extent that many students regard it as possessing a meaning inexplicable by ordinary language and utterly undefinable, and that it can only be comprehended by the development of a sort of special sense, which enables us to understand things without being able to explain them.

There is no reason, however, why any more mystery should attach to the word "potential" than to the word "motion," and, to be more general, there is no reason why any of the technical terms used in the electrical science should be enshrouded with mystery; they are all easily understood if a little thought is bestowed upon their meaning. The mere verbal *expression* of a technical term, whether it be volt or megohm, does not necessarily convey its meaning. Thought is required, as well as an expression, and in this respect the study of electricity is no different to the study of the multiplication table.

The definition of "potential" is, briefly, *possessing latent power;* that is, stored power which may be utilized to perform work under proper conditions. If we take a weight *w* (Fig. 1) weighing, say 10 lbs., and haul it up from the ground a distance of 10 feet, it will be endowed with a certain amount of power to do work, which it can be made to perform by its descent to the ground. This work can be applied in a great many ways. For instance, the end of the rope *a* might be attached to a train of clockwork which would be set into motion by the descent of the weight; or it might run a fan, a sewing-machine, or do any other kind of work, providing the weight was sufficient to overcome the friction of the mechanism. The weight then at a height of ten feet from the ground has a *potential energy* of a given amount — potential energy, meaning latent energy, which is transformed into work when the weight descends. Should the friction of the train of clockwork *c*, and the pulley *p*, be so great as to prevent the weight *w* from descending, no work will be performed; but if the total friction is slight, then the energy of the weight can be utilized to perform work in some form or another.

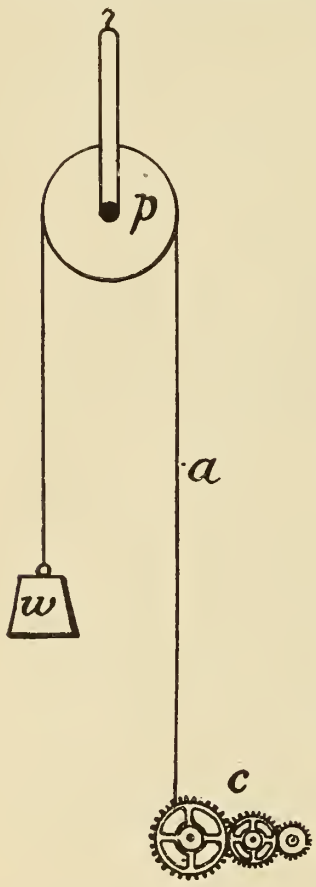


FIG. 1.

Now if we make the weight *w* 20 lbs. (twice its original weight), it will have twice the potential energy at the height of ten feet than it did before, and consequently, all things being equal, will perform twice the amount of work; it has twice the power to overcome resistance that it formerly had.

It is evident from these considerations that the greater the friction the less will be the amount of useful work available, and, on the contrary, the less the friction the greater the work. The same idea as to potential, or potential energy, is applicable to electric currents to express the power of a current to do work.

It is a difficult thing sometimes for beginners to get a clear conception of work done by electricity, but when it is remembered that work is required of the electric current to overcome the resistance of the conducting wire, to produce light in the electric lamp, to deposit metals in the plating bath and to propel street cars and operate machinery, just as work is required of the weight in the example, to overcome the friction of the pulley and clockwork a better idea of it will be possible. In an electric circuit of great resistance and with little potential energy at the source of current little or no useful work will be performed, because all or most of the power of the current is wasted in overcoming the resistance of the wire, which is analagous to the friction of the pulley and the wheels of the clockwork in Fig. 1. It is evident, therefore, that in order to get the greatest amount of power or work from a given electric current, the resistance to the current must be made small, so as to enable us to deliver as much of the current as possible at the point where the work is to be performed.

Electric potential, or electromotive force, is the power an electric current possesses to do work. All its energy may be spent in overcoming the resistance of the conducting wire, in which case none will be available to operate a telegraph instrument, give us light or drive an electric fan motor to keep us cool in hot weather, and it is the business of the electrical engineer to

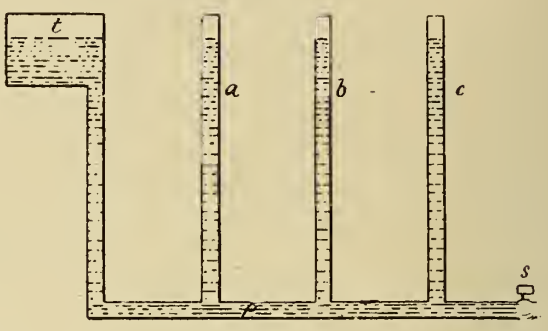


FIG. 2.

so regulate the conditions that everything else is subordinated to the one central object, namely, to get as much current as possible from a given source to the point where it is to be used.

The phenomena of electrical potential can be represented graphically in a way that will give us some conception of its nature.

Electricity, however, is something that cannot be seen or felt; therefore it cannot be represented by visible characters, so that we can get some idea of its nature through the eye. For this reason we are compelled to resort to analogy when we desire to illustrate the phenomena of electrical action.

It has been found that water, to a great extent, obeys laws which are very similar to those governing electric currents, and for this reason it is customary to illustrate the action of electric currents by analogy with the action of water under similar conditions.

Fig. 2 shows a tank of water *t*, to which is connected a pipe *p*, having at the opposite end a stop-cock *s*. Along the horizontal limb of the pipe are erected other pipes, *a*, *b* and *c*, in which the water can rise. Now when the stop-cock is closed and the tank is full of water, the water in the pipes and in the tank will be at the same height; under these conditions the same potential exists in the water in the tank and the pipes, but the moment we

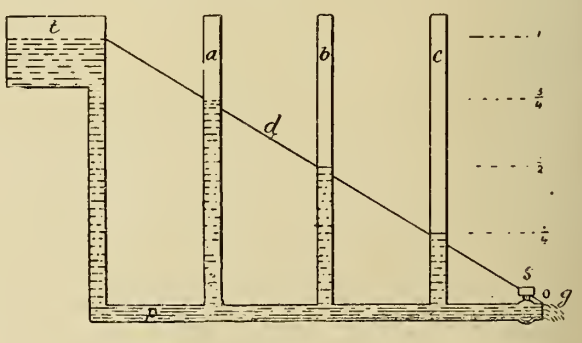


FIG. 3.

open the stop-cock and allow the water to escape the conditions are greatly changed, as will be seen in Fig. 3. The potential of the water in the tank will remain the same as it was before, provided that the supply is equal to the waste, to keep it at the same height, but the potential in the pipes decreases to the extent represented by the diagonal line *d*. When the water reaches its lowest level *g*, its potential is said to be zero, and if we tap the pipe *p* at any point along its horizontal length and insert other pipes perpendicularly, the water will rise in each of these to exactly the point where the diagonal line crosses (Fig. 3).

By actual measurement it will be shown that the water in pipe *b*, is exactly one-half the perpendicular height of that in the tank,

therefore the potential of the water in that pipe is one-half of that in the tank; the potential in pipe *c* is only one-fourth that of the original, and the potential at *a* is three-fourths.

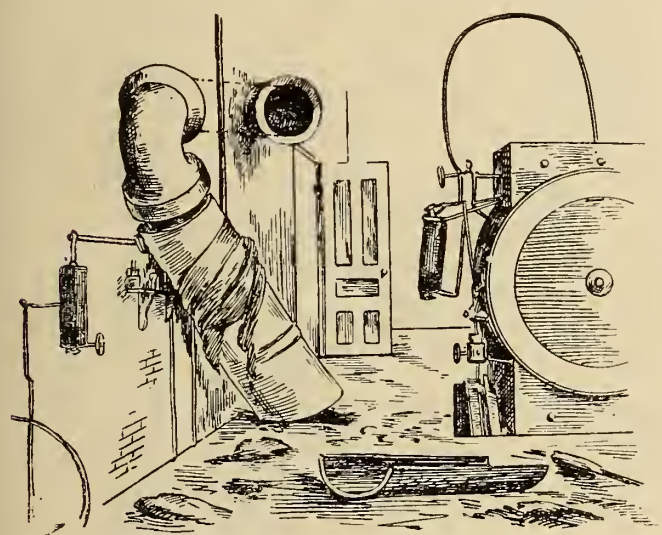
To the beginner this water illustration may seem irrelevant to the subject of this article, but such is not the case, because what is true of the action of the water in these examples is equally true of electricity under analogous conditions. If we now substitute the word "electricity" for "water,' and go over the same ground, we have the exact facts before us as to an electric current. In the place of the tank *t* we put the dynamo or battery, or whatever the source of current may be, and connect thereto one end of a wire which will take the place of the pipe *p*, and insulate the further end of the wire; that is, not connect it with anything, but leave it free, hanging in the air for instance, the electric potential at the free end, or at any point along the wire between that end and the source of the current will be the same as that of the source itself, as in the case of the water illustration (Fig. 2). If, however, we connect the free end with the ground or earth at *g*, the potential or electro-motive force will drop at the rate indicated by the diagonal line in Fig. 3 until it reaches the earth, where it will be zero—the potential of the earth being zero.

By taking measurements at any point along the wire the potential will be found to be exactly that shown by the intersection of the diagonal line (drawn from the point of highest to the lowest potential) with a perpendicular drawn from the point of measurement.

We have endeavored in this article to give as clear an idea as possible of the meaning of the term "electric potential" or "electromotive force."—*Electrical Age.*

AN ACCIDENT IN AN ENGINE-ROOM.

A short time ago a serious accident occurred in the engine-room of a New England mill, which was instructive enough to merit wider publicity than it has yet had. The engine is a 1, 200 horse power Corliss, and it is supplied with steam by a 14-inch



THE ENGINE ROOM AFTER THE ACCIDENT.

steam main, which enters the room about nine feet above the floor, passing horizontally along the wall for about eight feet, and then turning downward and connecting with a pipe under the floor that supplies the engine from beneath. This main steam-pipe is fed by smaller pipes running into it from each of the ten boilers in the boiler-room, and it is provided with a main stop-valve which is just outside and above the engine-room door, shown in the cut.

The engineer was just starting his engine up in the morning, when, without warning, the eight-foot section of pipe running along the wall (indicated by the dotted lines) burst with a noise like a cannon, and steam at 100 pounds pressure rushed into the engine-room with frightful velocity. The engineer was at the throttle-valve between the two cylinders (to the right of one shown in the cut), and the powerful current of air and steam rushed against him bore him helplessly across the engine-room, by a door that our artist has not shown. He struck the casing of the door, succeeded in gaining sufficient footing to jump out instead of being blown out. The ground is twenty feet or more below the floor still, and the engineer says it seemed fully a minute before he landed. His right knee was badly sprained by the fall, but he hobbled around to the boiler-room, and with the assistance of the two firemen, tried to close the main stop valve over the engine-room door. This was a difficult thing to do in the blinding blast of steam that issued from the engine-room, and the effort proved fruitless. The valve failed to work, and the smaller stop-valves on the individual boilers had to be closed before the draught of steam could be checked.

When the engine-room could be entered it was found that the heat of the steam had unsealed the automatic sprinklers on the ceiling, and a perfect storm of water was pouring down on the engine. The water supply was shut off, and the engine was examined and found to be uninjured, save for some rust that afterwards formed on the wet metal.

The large cast-iron main that had burst was found to be split in halves, lengthwise, and fragments of it lay about the floor. An examination of the large piece shown in the foreground of the cut revealed the cause of the accident. On either side of this piece, where had been the parting of the mold, the casting was defective, and for perhaps four feet on both sides the metal was hollowed and blown, so that there was no union whatever, the casting being held together by a scale of iron hardly a sixteenth of an inch thick in places, and hardly an eighth of an inch thick is most of its length. The upright length of pipe that ran down through the floor was blown over about six feet, so that the joints and valves under the floor were badly twisted and bent. Fragments of the bursted pipe struck and ruined the valve oiler on the cylinder, and a Locke damper regulator on the wall was also broken, the weights belonging to it being strewn all over the engine-room floor. One weight, weighing about ten pounds, was driven across the room and inbedded in the wall, making a hole eight inches deep and a foot in diameter.

The engineer was carried to his home after the accident, and it was found that his injuries, although serious and puinful, were not fatal.

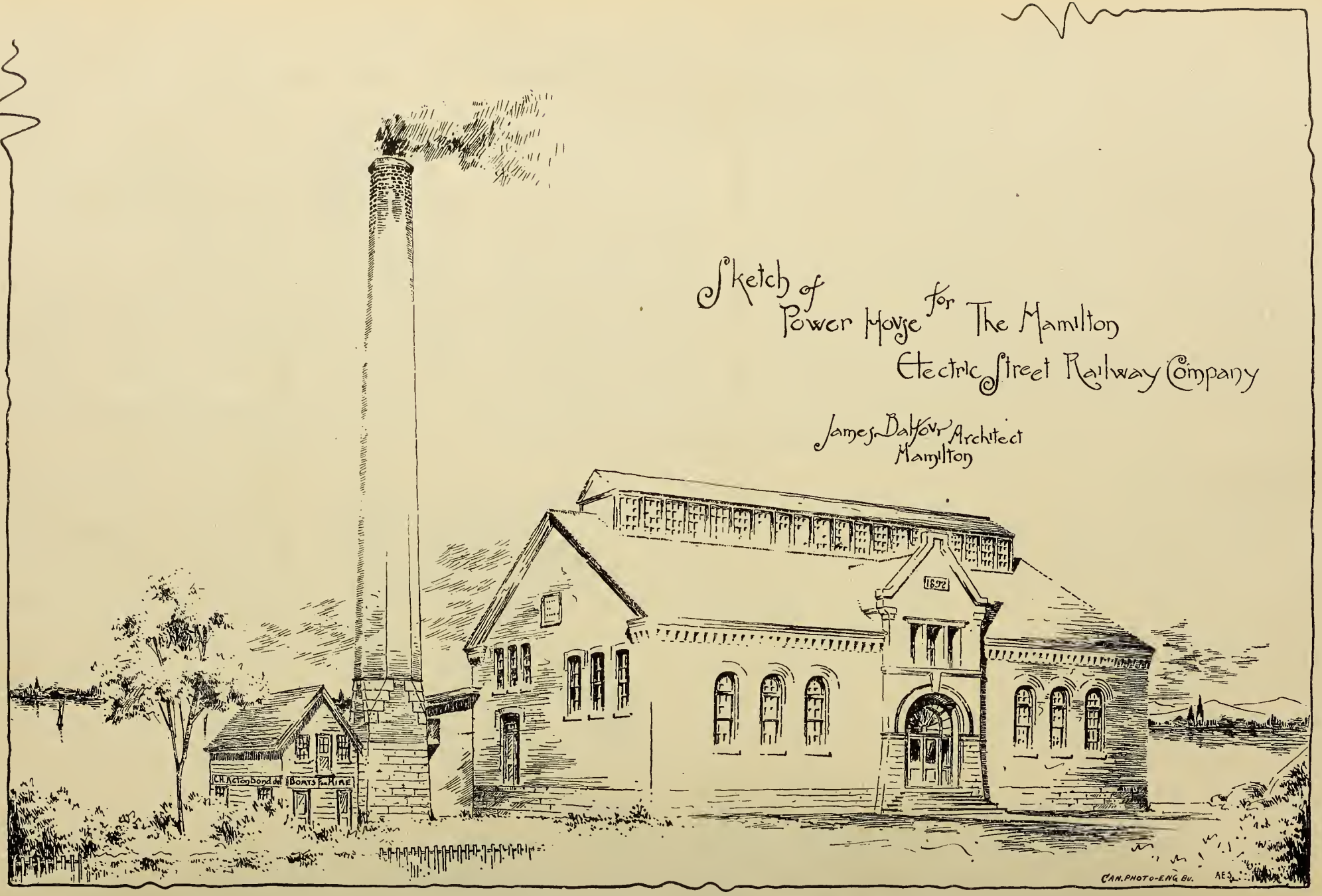
The moral of this accident is, that cast-iron ought not to be used for large steam mains carrying heavy pressures. Certainly, such pipes ought not to be used unless they have been thoroughly tested hydrostatically and with the hammer; and our opinion is, that wrought-iron pipes are always much safer and better.

While the failure of this pipe was due to its inherent weakness, accidents of a similar nature are often caused by the pipe being improperly supported. Suppo ts provided for main steam pipes should receive the most careful attention, especially if the pipe is a long one. Steam pipes are exposed to great variations in temperature, and the consequent expansion and contraction is often very considerable, and needs to be properly provided for. —*The Locomotive.*

LIABILITY OF TELEGRAPH COMPANIES.

In a suit for damages, recently brought for delay in the delivery of a message announcing the death of the father of the plaintiff's wife, it appeared that had no delay occurred the plaintiff and his wife could have reached the place in time to aid and direct the funeral and burial, going by train, but owing to the delay they were only able by private conveyance to reach the place in time to meet the burial procession. The telegraph company admitted liability for actual damage in the extra expense of the trip, but denied liability for injury to the feelings. The Texas Commission of Appeals, Section A, held (Western Union Telegraph Company vs. Erwin) that it was the right of the plaintiff and his wife to be present before the funeral, and to aid and direct it; that the delay was the direct cause why they were deprived of this privilege; that the injury to feelings and mental suffering sustained in being deprived of this right was but the effect occasioned by the wrongful failure of the defendant to perform its duty, and for damages resulting therefrom the defendant was liable.

Induction is a wide subject. The telegraphist both uses and endeavors to get rid of it, the telephonist depends entirely upon it, and his subscribers villify it, while the electric light installer finds it necessary to eliminate it here and appropriate it there. We now have a system from Edison of telegraphing without wires between elevated surfaces, the whole intervening space being rendered inductively active at will by an interrupted current. What limits are there to the effects of electrical induction through space, or action at a distance, and what may not come of it?—*The Engineer* (London).


Sketch of
Power House for The Hamilton
Electric Street Railway Company
James Balfour Architect
Hamilton
1892
CAN. PHOTO-ENG. BU.

HAMILTON ELECTRIC STREET RAILWAY POWER HOUSE.

The accompanying illustrations represent the new power house of the Hamilton Electric Street Railway. The building is constructed of red brick, on a stone foundation, and is situated on Cruise street, foot of Hughson street, on the shore of Hamilton Bay. Thus facilities are afforded for the direct landing of coal from the boats and an abundant supply of water for condensing and other purposes.

The engine and dynamo house is 64 × 102 feet, and the boiler house 40 × 102 feet. The chimney stack reaches 140 feet in height, the foundation being secured by cement and spiled.

The motive power consists of three Wheelock tandem compound condensing engines, 260 h. p. each, manufactured by the Goldie & McCulloch Co., of Galt, three 250 h.p. Westinghouse dynamos, supplied by Ahearn & Soper, of Ottawa. Two of the dynamos are kept constantly in use, the third being in reserve. There are six boilers, supplied by the Goldie & McCulloch Co., four of which are in operation and two in reserve. Generators, two in number, have a capacity of 250 h.p., and are called upon to operate at times 26 cars and 10 trailers.

A special feature is the belting of the dynamos direct from the engine fly-wheel, the pulleys employed ranging in size from 18 feet down to 34 inches.

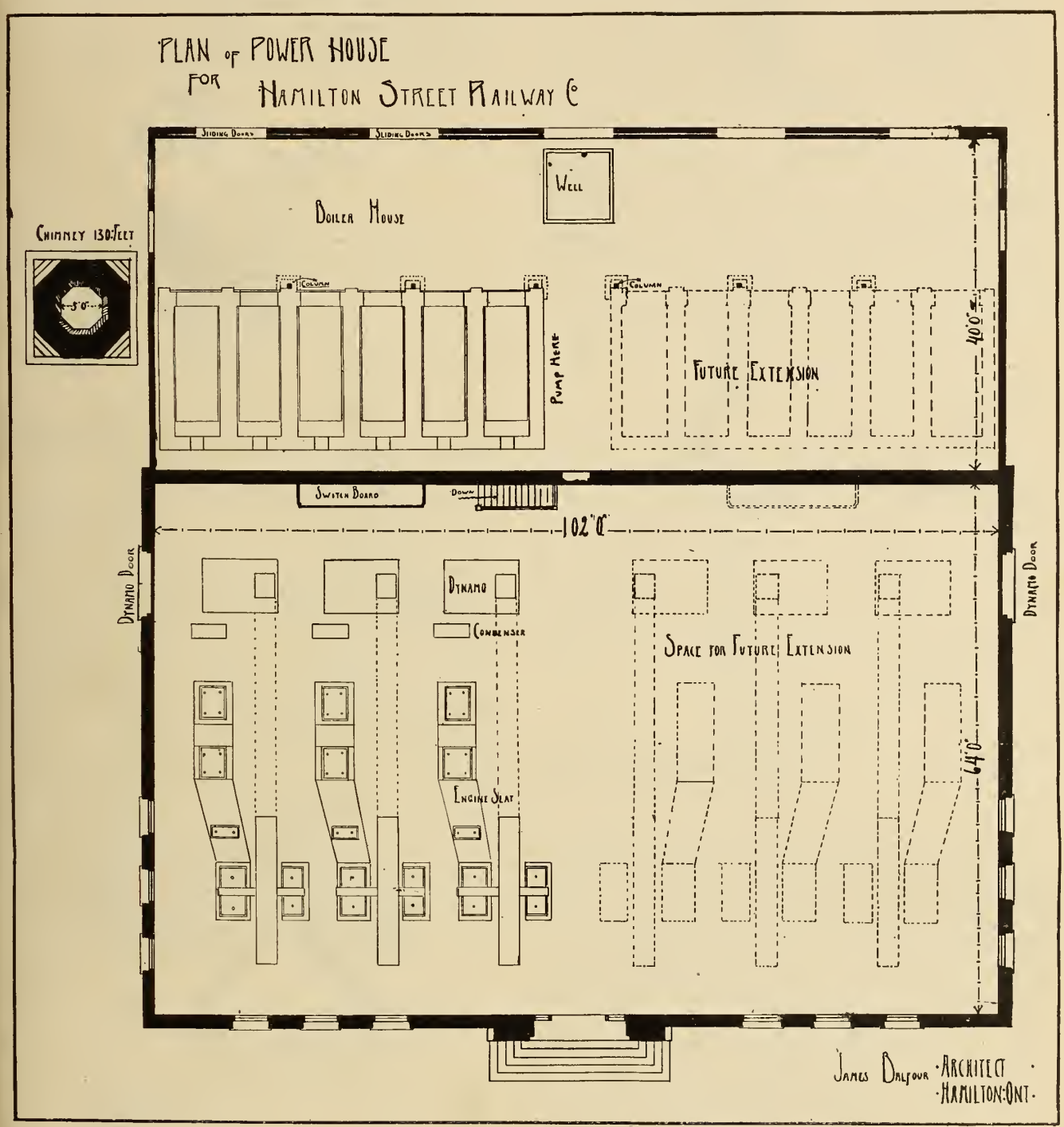
The switchboard is of mahogany. All the apparatus connected therewith is perfectly insulated.

The wires are encased in wood sheeting the entire length of the power house, with doors for access. The Edison Co.'s wire is used—No. 0000 cable.

Only about one-half the space in the building is at present utilized, the remaining portion being available for future increase of plant.

The installation of the plant was done under the supervision of Mr. R. S. Fiecht, electrician for the Westinghouse Co., of Pittsburgh. Mr. Potter is chief engineer.

It is the intention to extend the water intake pipe further into the bay, as under present arrangements the water has proved to be too warm for condensing.



PERSONAL.

An invitation to attend the annual clam bake, under the auspices of the Eugene Phillips Electrical Works, found its way to us while rusticating in the wilds of Muskoka. Unfortunately for ourselves there was no fast train available to convey us to the scene of festivity, but we do not doubt that to many more favorable circumstanced, the occasion was one of much pleasure. Mr. John Carroll, of the Canadian branch, was one of the committee of management.

The cross-head sometimes gives trouble. When it slips up and down between the sides, and is loose, it shows that it has worn the lower brasses, and as a consequence the piston has dropped and is out of line. This has a tendency to cut the piston, and if out of line to a great extent, will cause very serious trouble. Liners should be put in and the cross-head properly raised until it is not loose.

SAFETY VALVES—THEIR HISTORY, ANTECEDENTS, INVENTION AND CALCULATION.

By William Barnet le Van.

(Continued from June Number.)

AN IDEAL SAFETY VALVE.

The theoretical action of an ideal safety valve would be to prevent the slightest accumulation of pressure above the amount intended and not to contribute to the falling of the pressure below that amount; that is to say, the moment the normal pressure began to be exceeded, the valve would rise to admit the escape of steam, and would rise to just the extent necessary to allow the proper quantity of steam to escape, and the moment the tendency to undue accumulation ceased, the valve would close; and at all intermediate stages of time between its first opening and its closing, the amount of opening would be exactly proportioned to the surplus steam formed. Practically, we know it is impossible to construct such a valve, the first difficulty we encounter being the friction of the valve and its holding-down apparatus, which prevent the valve rising until some slight accumulation of pressure has taken place, and which prevents its closing until the pressure has fallen somewhat below the normal point. In practice, a valve never presents at its first opening sufficient orifice for the escape of all the surplus steam the boiler can generate, but it is only after the pressure has risen somewhat above the point necessary to open the valve, that the orifice becomes sufficiently large. The cause of this is generally understood to be that the further the valve rises from its sit the greater is the decrease of pressure due to the issue of tha steam compared with the pressure inside the boiler, therefore the greater the height to which it is necessary to raise the valve the greater the surplus pressure in the boiler must be to raise it, and thus. to give sufficient area for the discharge of all the steam a boiler can generate, the pressure must rise in the boiler above the intended limit—that is, above the point at which the valves are arranged to begin to blow off.

THE FIRST EXPLOSION BY AN OVER-WEIGHTED SAFETY VALVE.

Dr. S. Gravesande, secretary of the Dutch embassy, who were in England in 1716, saw Captain Savery's pumping engine, and afterwards had one erected for a friend. He gives the following description of the boiler exploding—the first on record:

"The boiler was made spherical. Upon the safety valve there was a steelyard, the place of whose weight shows the strength of the steam, and how high it was capable of raising water (24 feet high). But when the weight was at the very end of the steelyard, the steam then being very strong, would lift it up, and go out at the valve rather than damage the boiler. But a man who was entirely ignorant of the nature of the boiler, without any instructions, undertook to run it, and, having hung the weight at the further end of the steelyard, in order to collect more steam to make his work quicker, hung also a very heavy plumber's iron upon the end of the steelyard. The consequence proved fatal, for, after some time. the steam, not being able, with the safety clack, to raise up the steelyard, loaded with this unusual weight, burst the boiler with a great explosion, and killed the poor man in attendance, by the pieces that flew asunder, there being otherwise no danger, by reason of the safety valve being made to lift up and open upon occasion."

VACUUM VALVES.

A vacuum valve is a safety valve, opening inwards, for admitting air and preventing collapse in the shell when the pressure in the boiler is much less than that of the atmosphere. Falling of pressure in the boiler may arise from condensation of steam by gradual cooling after the fires are withdrawn.

THE DEVIL RAN AWAY WITH THE SOUP.

The advantage of having vacuum valves on steam boilers and steam supply pipes, is best illustrated by W. F. Durfee's description of how the devil ran away with the soup from the kitchen at the old City Hospital, which formerly stood for many years on the west side of Broadway opposite Pearl street and between Duane and Anthony streets, New York city.

Mr. Durfee says: "About the year 1850, I accompanied my father to New York, his purpose being to visit some of the public institutions with a view of studying the various methods then in use for cooking and heating by steam, and among other places of note we went to the above named hospital, whose superintendent very courteously showed us through the building and explained the system used for heating, ventilating and cooking. When we came to the kitchen, we found three (I distinctly remember that they seemed to me enormous) large iron caldrons grouped together in the centre of the room. These were provided with wooden covers having hinged lids, and we were told that they were used to boil the soups and meats by blowing steam directly into them through a pipe which entered the centre of their bottom. On my father inquiring if that method was found to be satisfactory, the superintendent replied: 'Yes; except one instance.' He then told us that one day the chief cook (who was a Frenchman) came rushing into his office with every hair on end, and his face livid with fright, exclaiming: 'Monsieur! sacré Moïse! ze diable avez rund avay mit mon soup. Zer es not un piece of ze soup; ze diable avez him entierement. Ah! Monsieur, wit me come, vouz sal see wiz vouz eye. I say ze vérité. Parbleu! Monsieur, et es ze grand Satan!' I supposed, said the superintendent, that my cook was either insane or drunk, but I accompanied him to the kitchen, and on lifting the lids of those kettles, there was not one drop of soup to be seen, and only a few grains of rice to show that there had been any there. Voila! vous zee vat I tell'd vouz; zee diable il a ze soup! Sacré Moïse, vat sal ve do?' exclaimed the cook, and I had began to think that his theory had appearances to justify it, if nothing more, and I certainly had no explanation of my own ready for the occasion. However, investigation was in order, and its result showed that the cook was not far from right, for we very promptly discovered that the fireman was dead drunk, and, of course, had allowed the fire under the steam boilers in the cellar to go out, and as the boilers cooled, a vacuum was formed in the place of the steam, due to its condensation by the cold air surrounding the steam pipes and the top of the boiler, and as a consequence all the soup intended for that day's dinner had been drawn into the steam space of the boiler to satisfy its hunger; so the incarnate devil of drunkenness, in the person of the fireman, had deprived the establishment of a very important part of that day's dinner."

The lesson taught by this experience, is to be sure and put vacuum valves on boilers and check valves on steam pipes, when used under similar conditions. Probably the colloquialism, "In the soup" may have had its origin in the kitchen of the New York City Hospital forty years ago.

ATMOSPHERIC PRESSURE ON SAFETY-VALVE DISK.

The effect of atmospheric pressure on a disk can best be illustrated by the following simple experiment: If any one will take a piece of writing-paper about one inch in diameter, and place it on the open part of the head of a common tobacco-pipe, and insert in the paper three small pins as guides, he



Fig. 55.

will find it utterly impossible to blow the paper disk off the pipe by blowing down the stem. By reversing the pipe while blowing, the paper will not fall off, but in this position the moment one leaves off blowing it will drop. A disk of metal may be suspended in the same manner.

This phenomenon in steam was first observed by Clement Desormes, who communicated it to the Academy of Sciences of Paris, on the 4th of December, 1826. He observes that "when steam is compressed in a boiler so that a strong current is made to blow out through a small orifice, a metal plate or disk, on being presented at a little distance from the orifice, is forcibly repulsed; but if it is brought near, and pressed so as nearly to close the orifice and cause the steam to escape in a star-like form around the outside of the disk in radiant directions, an external pressure will be found to act upon the disk, and it can only be set at liberty by forcibly raising it."

On the facts observed by M. Desormes, Jacob Perkins makes the following remarks: The steam forces oft horizontally in every direction, as M. Desormes observes, in a star-like form. Now, as a strong current of air will be created by the velocity of the steam, and pass off with it, the surrounding air will follow, and in its course, as in Fig. 56, it will impinge on

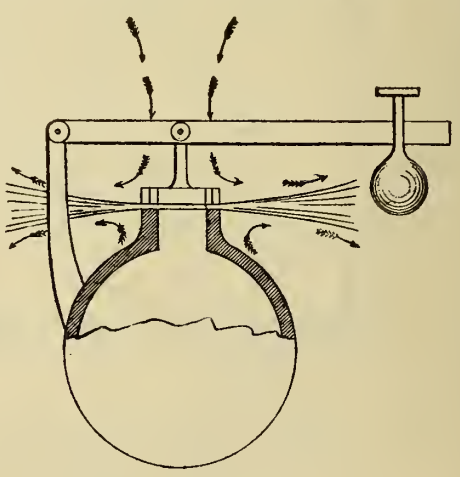


Fig. 56.

the disk and cause a pressure, and that in proportion to the height or velocity of the steam. When the safety valve is so constructed—which is sometimes the case—as to allow the steam to pass off in a horizontal direction, the pressure will be greater than when the valve is conical, which gives a different direction to the steam, as in Fig. 57, making it more difficult for the air to impinge upon the valve."

The peculiar behavior of a ball placed within the influence of either a vertical or inclined jet, was noticed by Professor Leslie, of Edinburgh, in 1825, as already mentioned; and Professor Faraday delivered a lecture at the Royal Institution, sometime between the years 1825 and 1829, in which the general action of jets upon the surrounding air, and, through this medium, upon balls and disks, was discussed. The "pneumatic paradox," in various forms, was illustrated in vols. IX. and XI. of the London *Mechanics' Magazine*, for the years 1828 and 1829, and received the attention of Professo

and other writers in the early volumes of *Silliman's Journal* and the *Journal of the Franklin Institute*. In the second edition of "The Boy's Play-Book of Science," published in 1860, Professor Pepper, in speaking of currents of air that are dragged into an escaping jet of steam, says: "This tendency of the air to rush into a jet of steam, was discovered by Faraday, and explains those curious experiments with a jet of steam by which balls, empty flasks, and globular vessels are sustained and supported either perpendicularly or horizontally. If steam, at a pressure of about 60 pounds

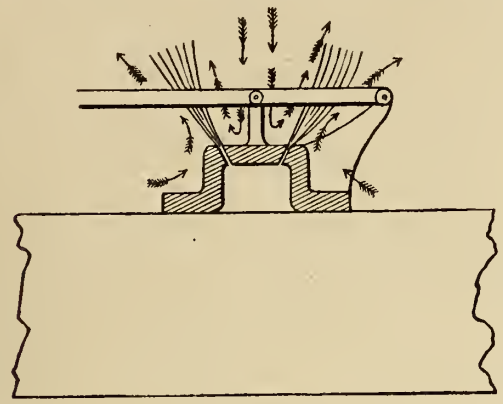


FIG. 57.

per inch, is allowed to escape from a proper jet, and a large lighted circular torch, composed of tow dipped in turpentine, is held over it, the course of the external air is shown by the direction of the flames, which are forcibly pulled and blown into the jet of steam with a roaring noise, indicating the rapidity of the blast of air moving to the steam jet."

Fig. 58 shows a jet discharging high-pressure steam; B, B, lighted torch held around the escaping steam. The flames from the latter all rush into the former. Egg shells, empty flasks, India-rubber or

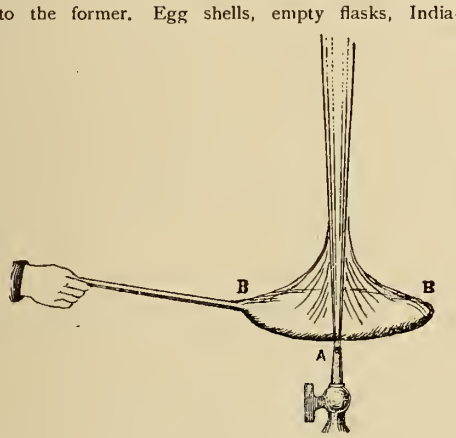


FIG. 58.

light copper and brass balls are suspended in the most singular manner inside an escaping jet of high-pressure steam, and before the explanation of Faraday reams of paper were used in the discussion of the possible theory to account for this effect; and what made the explanation still more difficult, was the fact that the jet of steam might be inclined to any angle between the horizontal and perpendicular, and still hold the ball, egg shell, or other spherical figure, firmly in its vapory grasp.

Fig. 59 is a ball-and-socket jet at an angle, and discharging steam. The egg-shells are supported by the enormous currents of air moving into the jet in the direction of the arrows.

In the latter part of the last century, the "principles of the lateral communication of motion in fluids," were investigated very thoroughly by

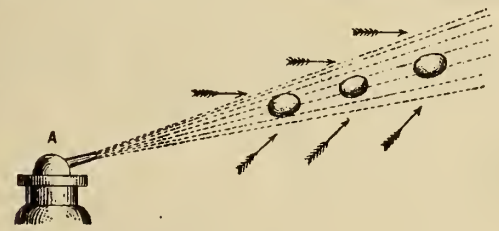


FIG. 59.

Professor Venturi, of Modena, and it is the action of the jet on the surrounding air, in accordance with the principles elucidated by him, that the support of the ball in all cases depends. The peculiar action of "induced lateral currents" of air is well illustrated by a simple experiment: Take a piece of ordinary writing-paper, roll it around a common lead pencil, and confine its outer edge with paste or gum, and on withdrawing the pencil you have a paper tube. Cut a circle of about 2½ inches across, out of a stiff card, and pierce its center with a hole about one inch in diameter; now attach the paper tube to the centre of the card by some sealing wax, and near the edge of the side opposite to that occupied by the tube, place three small drops of sealing wax at equal distances from each other; then cut another circle of card of the same size as the first; on putting this card on the drops of sealing wax before named, inverting the whole apparatus, and lowing forcibly through the tube, as shown in Fig. 60, it will be found to be impossible to displace the card, but as soon as the blast of air ceases the card will drop of itself; this is one form of the "pneumatic paradox" so called, and the support of the card is due entirely to the action of "lateral" or "induced currents" of air.

At the Centennial Exhibition at Philadelphia, in 1876, the curious phenomenon was shown of a ball sustained by an inclined current of air, which was shown in the exhibit of the Westinghouse Air-Brake Company. This

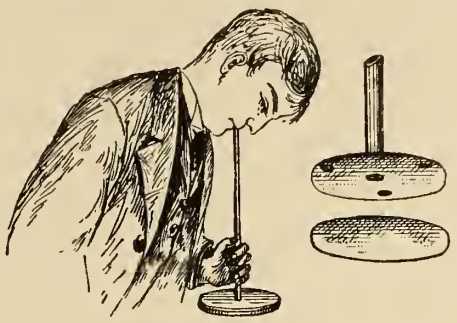


FIG. 60.

company had a receiver filled with compressed air, at about 70 pounds pressure to the square inch. When the brake on exhibition was not in operation, the air of the receiver, being continually supplied by an air pump, was allowed to escape through a nozzle of about ⅛ inch bore, set to a vertical inclination of about 30°. Over this jet of air was placed a ball (see Fig. 61), which remains afloat in the air without any visible means of suspension. There were five balls;—first, a solid glass ball of 1½ inch diameter; second, two solid wooden balls of 3 inches diameter; third, one hollow rubber ball of 3 inches diameter; fourth, one hollow rubber ball of 5 inches

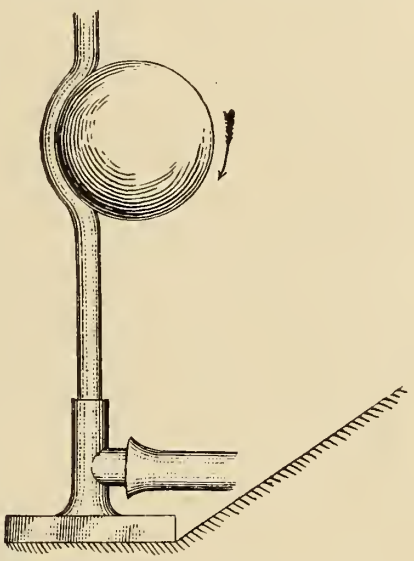


FIG. 61.

diameter. Each of the above balls, when placed in the air jet, showed this phenomenon.

Even more curious it appears when two balls are suspended simultaneously; the current of air, after leaving the small glassball, being sufficiently strong to give support to the largest (5 inches in diameter) of the rubber balls. The impression this experiment created was very striking indeed. As a rule, the suspended ball rotates very rapidly in the direction shown by the arrow, but sometimes it remains stationary, owing to the fact of the center of gravity not coinciding with the geometrical center; for the same ball once



FIG. 62.

made to rotate by an external force, will continue the rotation with increased speed. The vertical inclination of the jet may be changed to about 45° before the ball loses its state of suspension and drops off.

A similar phenomenon—a ball dancing on top of the water-jet of a fountain—is often seen, and will likewise remain sustained if the jet is more or less inclined. (See Fig. 62.)

(To be Continued.)

TORONTO NO. 1 C. A. S. E.

At the last regular meeting, July 8th, of Toronto No. 1, C. A. S. E., the following officers were installed, (having been elected at the previous meeting) :—A. E. Edkins, Past President ; W. G. Blackgrove, President ; Wilson Phillips, Vice President ; E. Phillip, Secretary ; C. Moseley, Financial Secretary ; A. M. Wickens, Treasurer ; W. Buttler, Conductor ; J. Fox, Door-keeper ; Trustees, W. G. Blackgrove ; W. Lewis ; C. Heal.

After installation, Bro. Edkins being called upon, for a few remarks, replied as follows :

"When I was elected to the office of president of this association some two years ago, I was very doubtful as to whether or not. I was qualified to fill such a position. I was conscious of not having had any experience in an office of the kind at the time, and as I then said, I felt that there were many members of the association who were in every way better qualified. However, I did my best for the year I way elected, and it was a matter of pride to me when I was elected for a second term, as I was then satisfied that I had filled the office satisfactorily.

Now that my term of office has just closed, and my successor in office has been appointed, I want to express my thanks to the officers of this association who held office during the past two years, for the very kind treatment and assistance which I have at all times received at their hands, and though, of course, we have had differences of opinion at times, yet we have at all times, as the saying goes,—"Agreed to disagree." At the same time I I am constrained to the belief, that, no matter how many our differences of opinion may have been, everyone had the welfare of the association at heart.

This association is one of the grandest things for engineers on this continent. I never knew the good that was being done indirectly by this body, until I entered my present employment. The engineers in the country are waking up, and commencing to realize the fact that to be a successful engineer a man must know something more than how to shovel coal. I claim that this association is and has been the cause of this good work. Engineers read of our meetings in the papers, and are beginning to see that it is only a matter of time until every engineer will have to give proof of his knowledge of steam boilers and engines. Many of them are acting accordingly, and preparing themselves for examination. Of course there are men (and plenty of them) who would not prepare themselves if they knew for a fact that an engineer's license law would come into force next month ; they would rather trust to some streak of luck, such as a good word from their boss, to get them a certificate. But when the time comes, these men will be "in the soup." By this I do not mean to say that men past the middle age, and who got no education when young, should be deprived of employment—far from it—I would fight for these men to have a certificate on passing a verbal examination, and producing proof of the number of years of their service as engineers. But I do maintain that the young men who have made up their minds to follow steam engineering for a living, and yet do not take any steps to post themselves in their business, will have only themselves to blame, when the day comes, that someone is appointed to question them and find out what they know.

But I am drifting a long way from what I started to speak on. We have only to stand by each other, and remain true to our obligation, to come out at the top. We must let no petty jealousies arise between us : if we do, they will do our organization more harm, than all our open enemies combined. Let us keep these points in view, and remember the fact, that, our employer's best interests are in the long run, our own. By studying his interests, we can as a rule, best convince him of our worth, as many engineers whom I could name have done, and have been rewarded by better wages.

In conclusion, I thank the members and officers of this association for the honor they have done me in electing me as president for the past two terms, and I can assure you that I shall always look back upon that time with a great deal of pleasure. I wish the association every success during the term we are now entering upon.

Presidents Blackgrove and Phillips promised to stir up old Toronto No. 1, during the coming year, so that the prospects are for a bright and prosperous year. The reports of committees show the association to be in good standing both financially and otherwise. During the past year the association has had many applications for engineers ; the employers are beginning to see that it pays them better to have thoroughly posted men to handle their engines and boilers.

During the past year the associations at considerable cost purchased an indicator and planimeter for the free use of its members. A large number of the members have taken advantage of this, and have become thoroughly posted in its use. In some cases quite a saving of fuel has been effected by the application of this indispensable little instrument.

The annual union picnic and games of Toronto, Hamilton, Brantford, Stratford, and London associations, was held July 1st, at Dundurn Park, Hamilton, when a large number of prizes were competed for. The event of the day seemed to be the ladies race, open only to engineers' wives. Mrs. Bain, of Toronto, secured the first prize, a beautifully figured card receiver, presented by Ryrie Bros., Toronto. Among other contributors to the prize list were the following prominent engine builders : Goldie & McCulloch, Galt ; Inglis & Sons, and the Polson Iron Works, Toronto. The thanks of the association are extended to all, who, by contributing to the prize list, assisted in making the occasion a success.

HAMILTON NO. 2, C. A. S. E.

Editor ELECTRICAL NEWS.

DEAR SIR,—At the last meeting of the above association held on July 15th, the officers elected for the ensuing year were installed by Brother J. Langdon. All the old officers retire except Bro. Langdon and Nash, the former as Conductor and the latter Financial Secretary.

After the new officers were installed they were called upon to make a few remarks, which they did, thanking the brethren for placing them in the different offices and promising to fulfill the duties to the best of their ability, also to try and keep the name of No. 2 to the front as it always has been since organization. A vote of thanks was tendered the retiring officers, which was responded to by the president, Bro. P. Stott.

Brother Langdon gave some good advice to the new officers and also to the members.

The officers for the ensuing year are ; Bro. Sweet, President; Bro. Cherriton, Vice President ; Bro. Langton, Conductor ; Bro. Johnson, Recording Secretary ; (Bro. Robb, who has held the position for four years, retiring) ; Bro. Nash, Financial Secretary; Bro. Nash, sr., Treasurer; Bro. Marshall, Door-keeper; Bros. Mackie, Dickenson and Robb, Trustees.

Fifteen new members have been admitted during the past year, and there are three applications in for membership.

Yours truly,

E. C. J.

LONDON No. 5, C. A. S. E.

Editor ELECTRICAL NEWS.

DEAR SIR,—The members of the various Associations of the C. A. S. E. in the Eastern part of the country will be glad to hear of the re-organization of London Association, No. 5. This Association was first organized on April 15th, 1890, and gave promise of being a useful and healthy institution, but unfortunately, after one year of existence the meetings became so poorly attended, that the few members who remained constant in attendance, decided that it would be best to discontinue the meetings until a re-organization could be brought about.

Bro. A. E. Edkins, ex-President of Toronto, No. 1, and who now fills the position of Inspector for the Boiler Inspection and Insurance Co., has been here on business for his company, and some of the old members of No. 5, (thinking this would be a good chance to get some help toward re organizing) held a meeting and invited Bro. Edkins to attend. At this meeting it was decided to send out notices to the Engineers, asking them to attend a meeting on Thursday evening, July 21st, at 8 p.m.

At the time mentioned about twenty engineers put in an appearance, many of whom had not been members of the Association before. The meeting was called to order by Bro. Geo. Taylor, after which Bro. Edkins was asked to preside.

Bro. Edkins proceeded to explain the aims and objects of the Association, and gave a review of the work which had been done by the C. A. S. E. during the past five years. The engineers present were then asked, if all would rise to their feet who had made up their minds to become members, and every man in the room but one complied. After the Secretary had received the

entrance fee from each of the new members, they were conducted by Bros. Taylor and Mungal, before the chair for initiation, the obligation being given by Bro. Edkins.

Nominations and election of officers followed and resulted in Bro. F. Mitchell, (Head Engineer, Dominion Oatmeal Mill), being elected President; Bro. T. Mungall, Vice-Pres.; Bro. J. McIntosh, Rec.-Secretary; Bro. Geo. Taylor, (Engineer *Advertiser* office), Treasurer; Bro. Powell, Conductor; Bro. Gilhart, Door-keeper; Trustees, Bros. Teen, Patterson and Westhead. The officers were then installed by Bro. Edkins.

President Mitchell made a neat speech, thanking the members for the honor they had done him, assuring them that he would do everything in his power to make No. 5 Association a success, and asking for the hearty co-operation of all present, in building up an organization of which they all might be proud.

A committee was appointed to secure a blackboard and question box. Bro. Edkins paid his entrance fee and was received as an active member of No. 5. The meeting adjourned to meet at 8 p.m. on the first Thursday in August.

There are many more good practical engineers in London who have signified their intention of becoming members, and, taking everything into consideration, No. 5 starts out with encouraging prospects.

Yours truly,

FOREST CITY.

ELECTRICAL ENERGY.

Whenever a current of electricity flows a certain amount of energy is expended, and it is necessary to be able to measure exactly the amount of energy so expended in any circuit or in any part thereof. The quantity of work performed in raising a mass of one pound through a difference of level of one foot against the force of gravity is generally taken as the unit of mechanical energy, and is known as the foot-pound. The work done in raising any mass through any height is found by simply multiplying together the number of pounds in that mass by the number of feet through which it is lifted. Somewhat similarly we can take, as the practical unit of electrical energy, the amount expended in transferring a unit quantity of electricity (one coulomb) through a difference of potential of one volt. And by multiplying the number of coulombs, which have flowed from one point to another by the difference of potential in volts between those points, we obtain the number of units of electrical energy expended during the passage of the current. The unit of electrical energy, or one coulomb multiplied by one volt, is called the joule. As a simple numerical example, we may suppose a current of 10 ampères to flow for 5 seconds, then the quantity of electricity passing through the circuit would be 50 coulombs, and if this current were maintained by a potential difference of 8 volts, the amount of energy expended in that time would be $8 \times 50 = 400$ joules.

As a rule, we wish to know the *rate* at which work is being done in any circuit rather than the amount which is done in a given time. It is evident that this rate can always be found by dividing the amount of work by the number of seconds taken for its performance; but the same same result can be arrived at by multiplying together the potential difference and the rate of transference or flow of electricity instead of the quantity actually transferred in a given time. Now the rate of flow of electricity is what we know as the current strength, which is measured in ampères. Therefore, if the difference of potential in volts between any two given points is multiplied by the resulting current in ampères the product gives the rate at which energy is being expended, or the rate of working between those two points. The unit rate of working or the unit of *power* is called the *watt*—that is to say, 1 ampère $\times$ 1 volt = 1 watt. Therefore, if a difference of potential of 20 volts between the ends of a wire maintains a current of 3 ampères the rate of working is $3 \times 20 = 60$ watts.—*Electrical Age.*

GROUNDS.

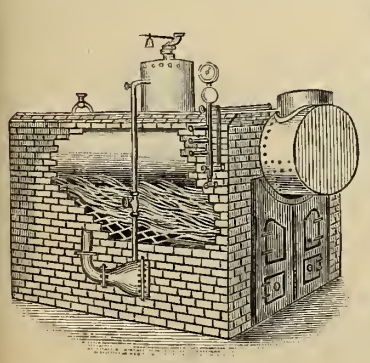
BY R. E. DALLAS.

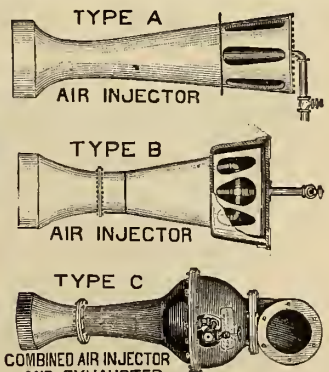
It is surprising to find in so many cases the omission, among the instruments on electric light station switch-boards, of any form of ground detector, the nearest instrument to it being the lightning arresters, which generally abound in number but serve for an entirely different purpose. Probably some are under the erroneous impression that grounds, and by grounds we mean leaks to earth or escaping currents, are of little or secondary importance and take care of themselves, while others, no doubt, consider them too difficult and expensive a matter to keep track of. For all such it is a pity that electricity was not favored with some sort of an odor, for instance, something similar to that of our ordinary illuminating gas, in which case leaks, etc., would probably be more frequently and speedily remedied.

The writer has in mind one large central station using low tension continuous incandescent current; the street feeders, mains etc., are run with bare copper, trees lie along the route of the poles, and in summer the wires are *insulated* with a dense covering of the green foliage; a wet night comes along, the lights burn cherry red, the fireman gets no chance to sleep, the consumer complains of unsatisfactory service, and the stockholder expects large dividends, with about one-half the station's output returning to mother earth, from whence it came, in the shape of coal. Surely this is a case of "dust returning to dust," and such an example ought to impress interested parties with the necessity of a high grade of insulated wires, and lines free from all grounds. Otherwise they always mean more steam coal, money, less dividends, and are like bad weeds which grow rapidly with out any fostering and no nourishment save that of the current.

New electric light companies should profit by the experience of their elders and "nip the evil in the bud" by starting in with clear lines and keeping them clear, which, of course, requires some little attention and care, but in the end undoubtedly pays. The mains being clear no service should be connected until they have been thoroughly tested and found clear. Experience teaches, also, that a few cells of some good type of battery and a galvanometer are much preferable to the magneto, ordinarily used in practice, and with the former much more accurate results will be obtained. This, together with some commerical form of wheatstone bridge and galvanometer are all the instruments required for ordinary testing.—*Electricity.*

Earle's Air and Steam Injectors





For burning hard or soft coal screenings under steam boilers, for working gas producers, &c., &c., exhausting gases from mines, ventilating ships, buildings, &c. Can be applied to any boiler without disturbing the present setting. Guaranteed to do the work satisfactorily. Can give the best of testimonials showing their efficiency. Fully covered by letters patent in Canada and the United States.

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TORONTO, March 12th, 1892.

S. R. EARLE, ESQ., Belleville, Ont.

DEAR SIR,—We are very much pleased with the Combined Air Injector and Exhauster purchased from you. We get more steam with less fuel than we could get with the fan blower we were using before introducing the air injector, and we can get along with all hard coal screenings such as we purchase from the local yards here, and there is an actual saving of 15% in favor of the injector as compared with fan. There is enough steam on the boiler to blow the fire in the morning. Five pounds will work the injector, whereas it took twenty pounds of steam to run engine and fan. We are more than pleased with our investment.

Yours truly, (Signed) THE GERHARD HEINTZMAN CO.

CIRCULARS AND PRICES GIVEN ON APPLICATION.

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TRADE NOTES.

Messrs. Darling Bros., of Montreal, manufacturers of the celebrated Claussen Clutch pulley and cut-off coupling, report the following recent sales: Grand Trunk Railway, Montreal, one 30″ × 7″ clutch pulley; Edison General Electric Co., one 66″ × 10″ pulley; The Rathbun Co., Belleville, one 40″ × 12″ pulley; Peck, Benny & Co., Montreal, two 36″ × 12″ pulleys; Citizens' Light and Power Co., three 300 h. p. clutch couplings.

It is customary, says the *Stationary Engineer*, to proportion the safety valve of a boiler to the amount of grate surface, allowing an area of one-half square inch in the valve, to one square foot of grate surface, but this can never be considered wholly reliable, as it does not consider the rapidity with which steam may be produced.

There is more trouble, in certain classes of engines, with the crank pin than with all other parts. If it gets hot, look carefully to the lubrication, and if the oil feeds properly you will probably find that the brasses are cutting. When this is found to be the case, take off the brasses, and if the pin is not much cut, use emery paper on it until smooth, or file it if necessary. Also file the brasses. If it is quite loose new brasses should be put on, and if they can not be had, the best thing to do is to drill holes in the brasses and pour in babbit metal. This often makes a better job than new brasses, but should be done carefully. The babbit plugs may slip out if not hammered in. If you want to fix them in so tightly that they can not come out by any means, drill your holes with a drill ground off at one side, so as to make it crooked, or larger at the bottom than the top.

SPARKS.

A branch of the Thomson Electric Welding Co. of Boston, has been recently established in the works of the Dominion Wire Co., Lachine, Que.

The Quebec & Levis Electric Light Co. has again secured the contract for lighting the Ancient City, at the price of $80 per light per annum.

The city street-car system of Quebec is to be improved and extended. Electricity will be partially adopted. The undertaking will probably not be commenced until next year.

Low speed dynamos are found more advantageous, in the long run than those operated at a higher speed. There is less wear and tear, consequently less repairs, and they require less attention.—*Stationary Engineer.*

The meaning of the term *earth* or *ground* in connection with an electric circuit, has been decided in the Lane-Fox trial in London, to embrace any return circuit whether connected to earth or carried by bare or insulated wires. Prof. Perry stated at this trial that *earth* was the technical term for a return conductor of any description and while strictly speaking this is probably correct, it is hardly the meaning ordinarily attached to the term in this country, and would cause confusion if not explained in every particular case.

TWO HARVEST EXCURSIONS

Via the Chicago, Milwaukee & St. Paul R'y, on Tuesday, August 30th, and September 27th, 1892.

Where the grasses are kissed by the wand'ring breeze,
And the fields are rich with golden grain;
Where the schooner ploughs through the prairie seas,
To its destined port on the western plain;
Where homes may never be sought in vain,
And hope is the thriftiest plant that grows;
Where man may ever his rights maintain
And land is as free as the wind that blows.

For further particulars apply to the nearest Ticket Agent, or address A. J. Taylor, Canadian Passenger Agent, 4 Palmer House Block, Toronto, Ont.

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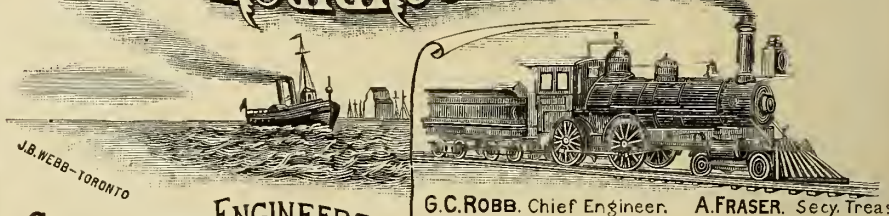
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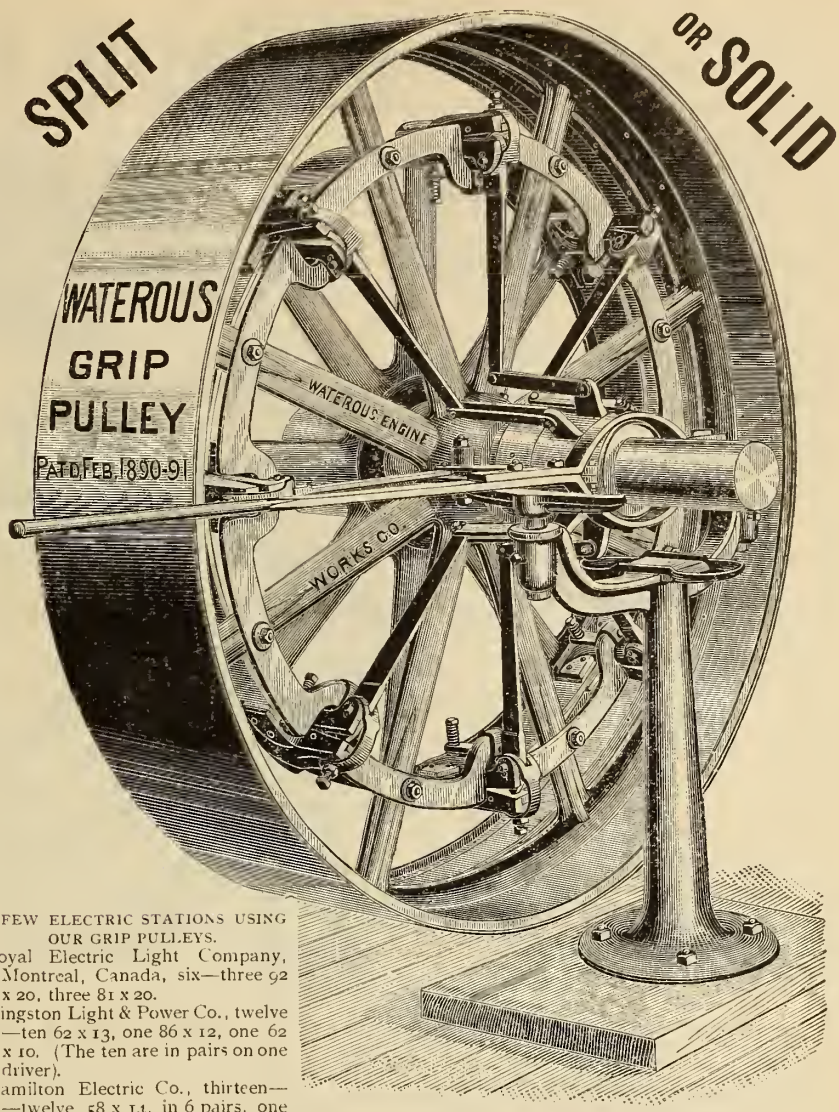
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A SINGULAR FATALITY.

The strange case of James Grant, a lineman employed by the Chicago Telephone Company, has excited much interest in Chicago. During the thunder storm of the afternoon of Monday of last week Grant had occasion to ring up the central office from the station at West Fortieth and Lake streets. A peal of thunder, following quickly upon a flash of lightning, rang out as he had the receiver to his ear. He fell to the floor. The bystanders ran to help him and found him breathing heavily and unconscious. He was taken to his home near by. Doctors came promptly. Efforts to restore him to consciousness were useless, and he lay insensible until Tuesday. When at last he awakened from the stupor his first words were : "Hello, ring off!" and this he muttered day and night. It was evident that the unfortunate man had become insane, and on Wednesday night he became violent, still laboring under the delusion that he was at the telephone. It was necessary to summon help from the neighborhood to restrain him. All night long he muttered, "Hello, ring off!" at intervals making frenzied attacks upon the men who were holding him in bed. The patrol wagon was called on Thursday morning and he was carried, feebly fighting, into a ward at the detention hospital. Throughout the day the afflicted man struggled pitifully with his delusion, and at 6 o'clock it was necessary to administer quieting medicines in order to get him to bed. At 9 o'clock he was quiet at last and breathing easy, with a decreased temperature. Twenty minutes later he aroused himself shouting, but without attempts at violence. The attending physician was called, and, as Grant's voice seemed to grow fainter, he found his pulse failing with it. At 10:25 o'clock, still persisting in his cry of "Hello, ring off!" sunk to a whisper, James Grant died.

The case is a mysterious one, and it is not known whether the lightning itself or the fall to the floor was the cause of the insanity and subsequent death. There are several instances recorderd in medical journals where persons have been rendered delirious by shocks of lightning, but none is known precisely parallel to Mr. Grant's sad fate.—*Western Electrician.*



A FEW ELECTRIC STATIONS USING OUR GRIP PULLEYS.

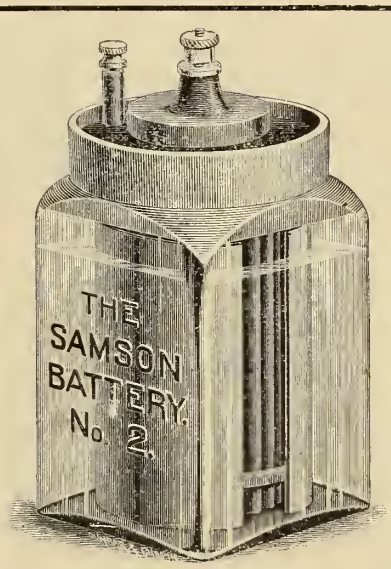
Royal Electric Light Company, Montreal, Canada, six—three 92 x 20, three 81 x 20.
Kingston Light & Power Co., twelve—ten 62 x 13, one 86 x 12, one 62 x 10. (The ten are in pairs on one driver).
Hamilton Electric Co., thirteen—twelve 58 x 14, in 6 pairs, one driver to each pair, one 105 x 20.
Hunt Bros.' Electric Station, London, six—58 x 9, 76 x 12, 72 x 16; two 100 H. P. couplings.
Windsor & Sandwich Electric Railroad, two—48 x 16, 60 x 12.
Nanaimo Electric Co., B. C., two, 30 x 8.
Electric Light Co., Rat Portage, one 48 x 12.
Halifax Gas Light Co., N. S., one 90 x 13.

300 H. P. GRIP PULLEY, FROM PHOTOGRAPH OF PULLEY FURNISHED ROYAL ELECTRIC CO., MONTREAL.

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HIGH GRADE MACHINERY **CANADA**

Many persons imagine that the electric light gives no heat, and are much puzzeled when told that the electric arc is the highest temperature known at the present day. It is perfectly true that arc lights are cool for illuminating purposes, for the actual mass raised to so high a temperature is extremely small for the enormous amount of light given out. It must also be borne in mind that arc lamps give off noxious nitrogenous fumes which are very noticeable in confined situations. Incandescent lamps emit absolutely no fumes, since they are hermetically sealed in glass globes. On the other hand, they produce a considerable quantity of heat, but far less than gas, or oil lamps, light for light; and, difficult as it may be to believe, wax candles give more heat, light for light, than either of the latter illuminants.—*Electrical Age.*

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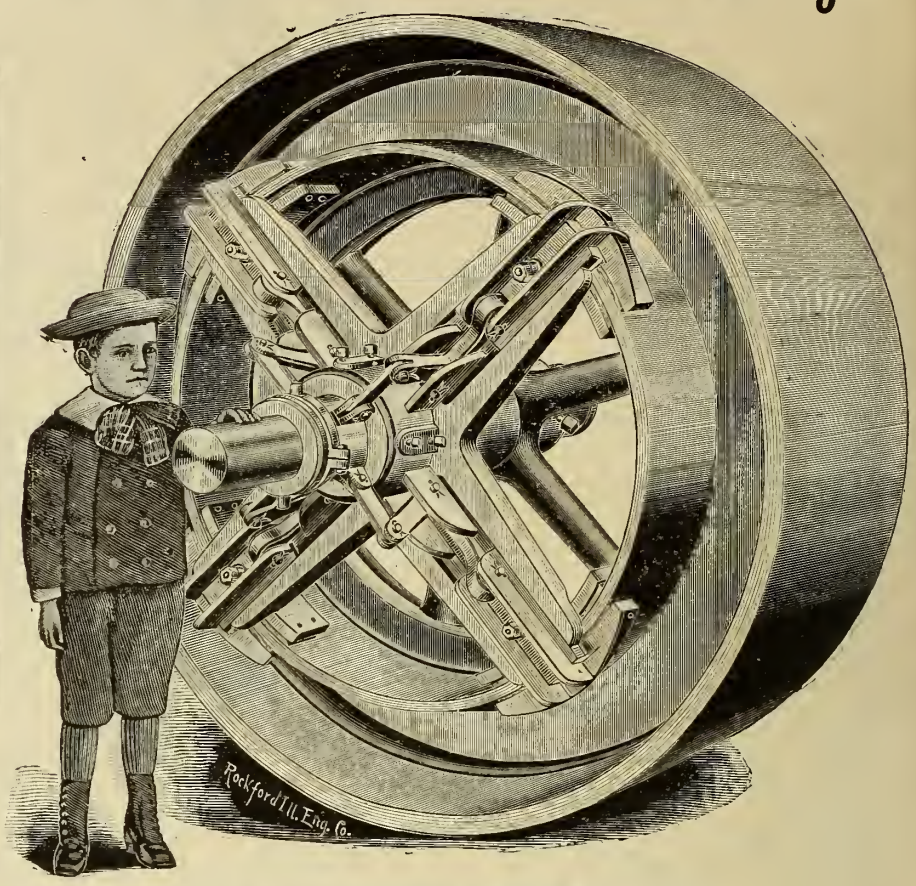
NOTES.

An engineer calls attention to the placing of a lubricator on a steam pipe, and thinks it makes a difference which side of the pipe it is placed on. Placing the cup on the side nearest one end of the cylinder, he found that end of the cylinder got the bulk of the oil which ran down the inside of the pipe. He now enters his oil supply pipe into the steam far enough to let the oil come into the center of the column of steam. This is done by tapping and running a short length into the steam pipe before attaching the lubricator.—*Boston Journal of Commerce.*

Some causes which produce over-heating: Heavy fire and sloggish draft; dirty boiler; with the spaces between tubes lined up; black oil mixing with scale and lying on bottom of boiler; filling furnace too full of fuel, of a kind that throws off intense heat, with not enough air to mix with it; clinkered grate bar and heavy fire on top, putting too much solvent in boiler, which causes all the stuff to fall on bottom of boiler; smoke stack neither large enough nor high enough. All the above will be indicated when too much heat burns off the liners of the fire front and throws an intense heat out towards the fireman. Another cause is the practice of filling furnace too full of fuel, and then, when steam is generated, too rapidly closing all dampers and draft inlets. When tubes leak at back end, particularly at the top rows, water has been let down too low in boiler; the same cause produces leaks on either side circles and seams, if at water line. Too much mud in boiler, either at bottom or around tubes at rear end, produces leaks.—*American Miller.*

The substitution of lead instead of zinc for coating or galvanizing conductors is advocated in an article in *L'Electricien*. Zinc has certain disadvantages—tendency to form an alloy, high melting temperature and tendency to flake. Lead seems to be preferable for certain reasons and its application is similar to that of zinc. The objects are cleaned electrically, and immersed in an aqueous solution containing 10 per cent. of hydrochloric acid and 1 per cent. of hydrofluoric acid, heated to 50° C. in a vessel coated with lead. They are connected to one pole of a dynamo as anode, the lead coating constituting the other pole. After this preparation they are dipped into limewater of the same temperature, and then into an alloy of equal parts of zinc and tin in hydrochloric acid, which greatly favors the adherence of the melted lead into which they are then dipped. The process is economical and is not confined in its advantage to iron or steel articles, but may be used for chemical and electrolytic vessels. The iron or steel wires serving as protection in armored cables, it is suggested, might be advantageously treated by this method in preference to the ordinary galvanizing process.

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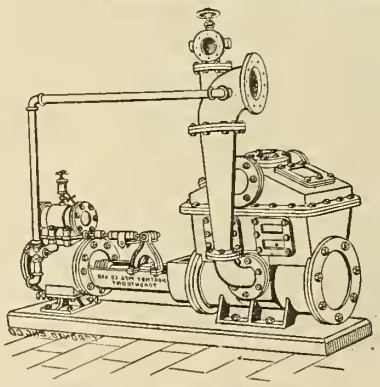
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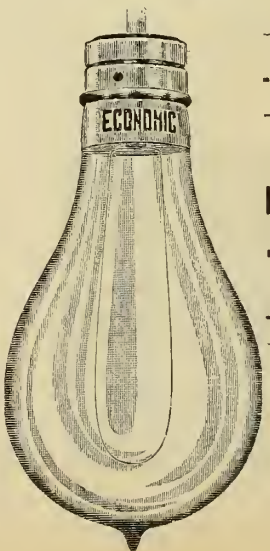
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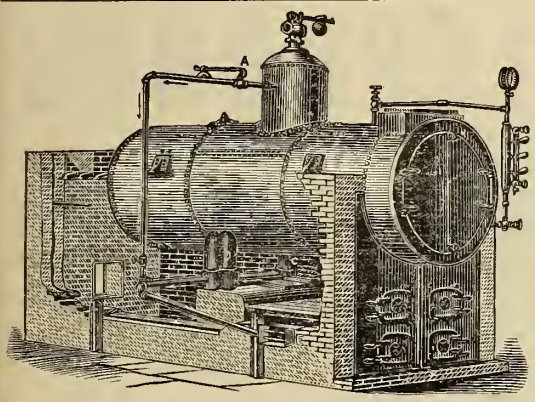
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One 36 inch belt 123 feet long. One 24 inch belt 100 feet long.
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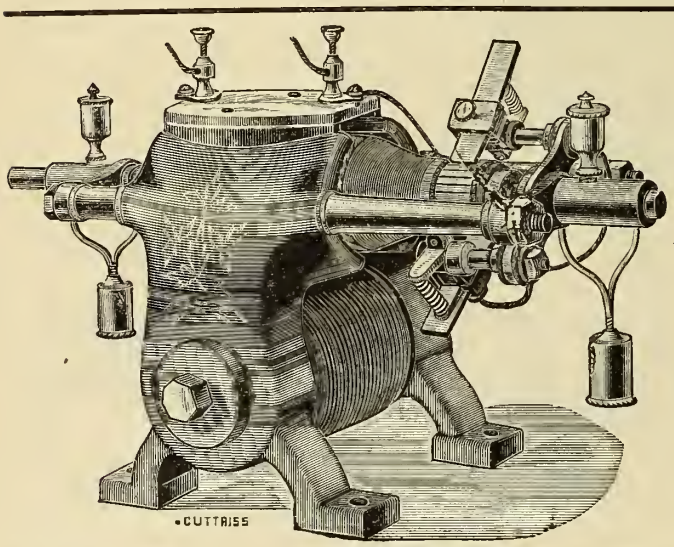
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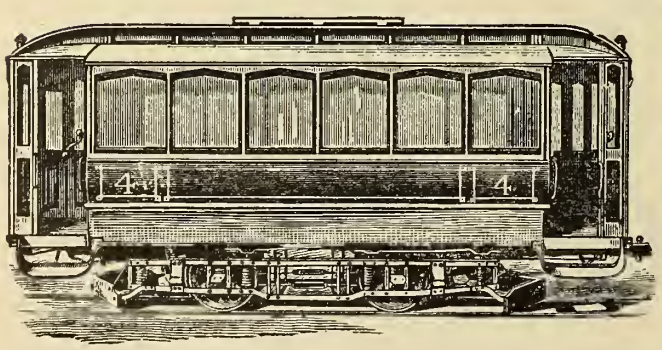
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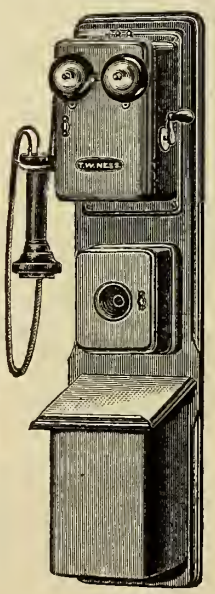


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Yours truly,

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CANADIAN

ELECTRICAL NEWS

AND

STEAM ENGINEERING JOURNAL.

VOL. II. TORONTO AND MONTREAL, CANADA, SEPTEMBER, 1892. NO. 9.

THE BELL TELEPHONE COMPANY'S NEW EXCHANGE, TORONTO.

THE Toronto offices of the Bell Telephone Co. have been removed to the Company's new building on Temperance St., but the removal of the operating room will not take place for some months, pending the completion of the new switchboard which is at present in course of manufacture at the Company's workshops in Montreal.

A recent inspection of the new building, which is nearing completion, shows it to be a most substantial structure, and designed in the best possible manner to meet the requirements. The building is stone and brick, three stories in height, and is said to be the only thoroughly fire proof structure in the city. The outer walls are 4 ft. thick at the base, and about 3 ft. thick above the foundations. The inner walls are of brick, and are supported by steel girders encased in hollow fire brick. The first and second floors are tiled, as also the lower portion of the walls of first and second story and of stairway. The only part which would be affected by fire would be the door and window frames as even the partitions dividing the various offices are of porus terra cotta. The wood work throughout is of cherry, and presents a rich appearance.

Half of the basement is occupied by the cables, which are brought in through a large manhole beneath the sidewalk; these cables will number about 125. Each of them will contain 100 wires, thus meeting the requirements of the exchange, which is designed to serve 5000 subscribers. These cables pass up through the floor above to terminals in the distributing room, from which the wires are carried beneath a false floor to the distributing rack, and from thence back beneath the floor and through a shaft to the switchboard. The remaining portion of the basement is occupied with the steam heating apparatus and for storage purposes.

Immediately to the left of the main entrance is a pleasant room which is to be fitted up as a reception room, and adjoining it will be the long distance telephone department; on the same floor are the store room, repair shop, testing room and lavatories.

The second floor is reached by an iron stairway having marble steps. The manager's office is located on this floor at the front of the building, immediately across the hallway being the public office and the offices of bookeepers, stenographers, etc. On this floor are the offices of the superintendent, a large battery room and a lunch and cloak room for the operators. The cloak room is provided with double lockers, each locker being divided for two operators.

On the third floor will be the operating room, around three sides of which will extend the switchboard, which will embrace every improvement which has been perfected up to the present time. The room is perfectly lighted by a large skylight. In the centre will be situated the chief operator's desks. There has been provided a second iron stairway, leading from near the centre of this room to the floor below, designed to afford an easy means of egress in cast of fire.

Everything is as yet in an incomplete condition, but it is safe to say that when all arrangements are perfected, the Bell Telephone Exchange in this city will be equalled by few and excelled by none on this continent. It is the Company's intention to erect shortly a storage warehouse, where all its supplies will be kept. The quantity of supplies required to be kept on hand for constantly extending the system and for repairs, is very large, as may be judged from the fact that the regular order for wire amounts to 150 miles per month. It is the intention also to erect, in the near future, branch exchanges in East Toronto and Parkdale. The Company give employment in this city to 250 persons.

The following extract from the last annual report of the City Engineer of Toronto, will serve to show the extent of the Company's operations in this city:

"From the manager of this branch, Mr. Dunstan, I have been furnished with the following statistics: As an essential feature of their reconstruction work in the central portion of the City, they have erected a new and central Telephone Exchange building on Temperance Street, at a cost in the neighborhood of $60,000, and it is in every way a thoroughly satisfactory, substantial and fire-proof Telephone Exchange. During the past five months the Company have moved their Yorkville branch to the south-east corner of Yonge and Bloor Streets, and have now at that place a thoroughly modern Exchange, equipped with a metallic multiple switch-board capable of serving 3,000 subscribers. The wires are all brought in under-ground to this office to cable terminals which are supplied with the best lightning and electrical arresters. In order to carry out this underground service and comply with the terms of their agreement with the City, the Company have placed a number of poles on side streets and alley-ways, have strung over 300 miles of wire, 300,000 lineal feet of aerial cable, and have brought into use over 31,830 feet of under ground-cable. They have supplied "second"wires to about one-sixth of the total number of subscribers in Toronto, thus giving them the great advantage of quiet metallic circuits, free from noise caused by electric induction. While this work of moving the Telephone Exchange has been going on, the Company on an average have put in about 100 new connections a month, each one of which necessitates the erection of outside line and interior wiring. There are now laid in Toronto 16,183 lineal feet of this Company's under-ground conduit, which contains 310,537 feet of duct, each duct being intended for one cable. This amount is made up as follows: 64,857 feet 2½ inch Macdonald duct; 55,312 feet 3 inch Macdonald duct; 190,368 feet 3 inch Wychoff duct, all of which is made of a specially prepared creosoted wood imported from the United States, and in such a manner as to exclude all moisture from the cables. Forty-seven man-holes, six feet square, have been constructed in connection with this conduit system, besides the large area in front of the Company's Central Exchange on Temperance Street, which affords access to this under-ground system. In order to move into their new building on Temperance Street, and work the new metallic system, and otherwise comply with the terms and conditions of their agreement with the City, the Company have to lay about 1,400 feet of conduit, equalling 162,500 feet of duct, and for this they purpose using cement-lined iron pipe, which, though considerably more expensive than creosoted wood, will, it is believed, be more durable and satisfactory. When this is done the Company will be able to remove 784 of their poles from the streets, which now carry 3,867 cross-arms and about 1,300 miles of wire. This new construction work will necessitate an expenditure for under-ground metallic line of between $175,000 and $200,000; and besides this there will be the work of erecting new distributing routes on the side streets, and building "second" lines to the 3,000 subscribers not yet having a metallic service, and the re-wiring of the interior of each one of these 3,000 dwellings or offices. Besides all this there is the moving of the main Exchange and the setting up of a complicated switch-board capable of accom-

modating 5,000 subscribers. This switch-board is now being manufactured at the Company's shops in Montreal, and will be of iron frame board of the most modern description, and will cost in the neighborhood of $50,000. The Company have also to duplicate the construction work done in Toronto during the past twelve years, and complete it inside of the next two years. The Company have now 3,843 subscribers in Toronto, and they are about combining the Toronto Junction service with that of the City, and they also purpose building another branch Exchange at the eastern end of the City. The Company also now have in use 3,406 miles of over-head wire, strung on 97 miles of poles."

ASSOCIATION OF EDISON ILLUMINATING COMPANIES.

THE thirteenth convention of the above association was held at the Rossin House, Toronto, on August 9th and 10th. Upwards of forty delegates were in attendance, among whom were Mr. Frederic Nicholls, manager Toronto Incandescent Electric Light Co.; Mr. John Langton, Canadian Works Edison General Electric Co.; Mr. M. D. Barr, District Manager Edison General Electric Co., Toronto; W. S. Andrews, General Superintendent Canadian Works Edison General Electric Co.

The proceedings, as on former occasions, were conducted behind closed doors, so that it is not possible to furnish our readers with a report of the meetings.

In view of the presence of the President and legal counsel of the General Electric Co., it may be presumed that the relation of the Edison Illuminating Companies to the General Electric Co., was up for consideration.

The Toronto Incandescent Electric Light Co., exerted itself most successfully on behalf of the entertainment of the visitors, who were treated to a moonlight excursion and luncheon, a drive round the city, etc.

The following are the officers elect for the ensuing year:

President—John J. Beggs, New York.

Vice-president—Frederic Nicholls, Toronto.

Secretary—W. J. Jenks, New York.

Treasurer—Wilson S. Howell, Orange, N. J.

Executive Committee—C. P. Gilbert, Detroit; C. L. Eager, Boston; E. R. Weeks, Kansas City; W. D. Marks, Philadelphia, Pa.; Samuel Insull, Chicago.

The place of next meeting will be chosen by the Executive Committee.

THE STEAM PUMP.*

The idea entertained by many engineers that water is raised by suction is erroneous, as, properly speaking, there is no such principle as suction. Water or other liquids are raised through a tube or hose by the pressure of the atmosphere on their surface. When the atmosphere is removed from the tube there will be no resistance to prevent the water from rising, as the water outside the pipe, still having the pressure of the atmosphere upon its surface, forces water up into the pipe, supplying the place of the excluded air, while the water inside the pipe will rise above the level of that outside of it proportionately to the extent to which it is relieved of the pressure of the air. If the first stroke of a pump reduces the pressure of the air contained in the pipe from 15 pounds on the square inch to 14 pounds, the water will be forced up the pipe to the distance of about 2¼ feet, since a column of water an inch square and 2¼ feet high is equal in weight to about one pound. Now if the second stroke of the pump reduces the pressure of the atmosphere in the pipe to 13 pounds per inch, the water will rise another 2¼ feet. This rule is uniform and shows that the rise of the column of water within the pipe is equal in weight to the pressure of the air upon the surface of the water without.

The distance that a pump will draw or lift water, as it is termed, is about 33 feet, because a column of water of one inch area 33 feet high weighs 14.7 pounds, but pumps must be in good order to lift 33 feet, and all pumps must be air-tight. Pumps will give better satisfaction lifting from 22 to 25 feet.

There are many things to be considered in locating a steam pump, such as the source from which the water is obtained, the point of delivery, and the quantity required in a given time; whether the water is to be lifted or forced directly into the boiler, or raised into a tank 25, 20 or 100 feet above the pump.

When purchasing a steam pump to supply a steam boiler, one should be selected capable of delivering one cubic foot of water per horse-power per hour.

No pump, however good, will lift very hot water, because as soon as the air is expelled from the barrel of the pump the vapor occupies the space, destroys the vacuum, and interferes with the supply of water. As a result of all this the pump knocks. When it becomes necessary to pump hot water, the pump should be placed below the supply, so that the water may flow into the valve chamber.

The most necessary condition to the satisfactory working of the steam pump is a full and steady supply of water. The pipe connections should in no case be smaller than the openings in the pump. The suction lift and delivery pumps should be as straight and smooth on the inside as possible.

When the water contains chips, shavings or sawdust, a strainer should be placed on the lower end of the pipe.

When the lift is high, or the suction long, a foot valve should be placed on the end of the suction pipe, and the area of the foot valve should exceed the area of the pipe.

A suction air chamber is a great advantage to the pump when the lift is high.

The area of the steam and exhaust pipes should in all cases be fully as large as the nipples in the pump to which they are attached.

The cylinder of steam pumps should in all cases be oiled before starting in the morning or stopping at night.

Stuffing boxes on the piston and valve rods should in all cases be kept well filled with soft and moist packing, as, if the packing is allowed to become hard and dry, it will flute the rods, inducing leakage and necessitating repairs.

The air vessel on the delivery pipe of the steam pump should never be less than five times the area of the water cylinder.

When the pumps are standing still, idle or out of service, in cold weather, all the drain, drip and pet-cocks should be left open.

* From a paper read by President Crowley at the late meeting of the N. A. C. E., Jersey City.

THE SPEED REGULATION OF CENTRAL STATION ENGINES.

By W. H. Booth.

IN *Cassier's Magazine* for May, an article appears under the above heading from the pen of W. S. Aldrich. Mr. Aldrich considers the desirability of some form of governor for steam engines, the action of which shall not be due to speed of the engine, but shall be controlled by the work to be done. There may not, it is true, appear to be much difference in the distinction here drawn, but there is very much more than at first sight is evident. In all ordinary governors there is a position of the governor which corresponds with the normal engine speed. When, by reason of load reduction, the engine begins to run faster, the governor takes up another position, being said technically to rise. In thus rising, it is made to act upon the throttle valve or other means of reducing steam supply, and it thereby prevents an indefinite acceleration; but is clear that the reduced steam supply can only be maintained by the governor being at a supernormal height, and, of course, this implies that the engine also will be above its proper speed. If a 2 per cent. increase of speed caused the governor to have such a motion that it cut down the steam supply below that necessary to run even at normal speed, there would be no steadiness of action whatever, for as soon as the engine ran slow, say 2 per cent., the governor would then turn on an excess of steam, and the fluctuations would never cease. Such a case demands that the effect upon the valve be made less by a re-adjustment of the connecting gear between governor and throttle. In the Corliss gear the same fault is introduced, for the position of the tripping cam depends entirely upon the height of the governor, and an earlier cut-off can only be secured by an addition to speed. Many years ago a Lancashire firm introduced a method of absolute governing, which combined the instant partial action of the governor upon the throttle valve, with a further mechanism for varying the cut-off valve, which was so devised, that whenever the engine revolved above or below its normal speed, certain wheel gear came into action, and through a differential motion changed the cut-off valve until the engine came back to its normal speed, the governor also resuming its normal height, and thus there was never for long any departure from best

speed. As a corollary to this effort, the Corliss valve makers were compelled to modify their Corliss gear, so that the same result was attained, and this they did by adding a second or supplementary governor, the duty of which was simply to turn a right and left screw by which was varied the length of the connection between the governor and the trip gear. By means of a piece revolving between two detents, it is easy to arrange any governor to any degree of adjustment, so that any departure from normal speed shall cause revolution one way or another of the screw sleeve. In the Corliss gear the supplementary governor did this. Supposing a change of engine speed causes a pull of, say, ¼ inch in the trip rod; the supplementary governor puts into gear a winding train, which turns in the screw sleeve in this rod untill the ¼ inch of pull has been let out again. The tripping piece being thus still held at the position it was placed in by the governor, while the latter has been allowed to fall back to position of normal speed, this supplementary action will always bring the engine to its normal. In the old Boulton and Watt days a certain percentage of speed variation was allowed and a suitable fly-wheel added.

As Mr. Aldrich points out, there is a difficulty with large engines in regulating them for sudden and heavy variation of load. In an engine of high reciprocation, say, of ten working strokes a second, the load variation can be coped with in one-tenth of a second, but with large engines where, say, for a 1,000 horse-power, a suitable quantity of steam has been admitted to the cylinder to maintain such power, a sudden decrease of 500 horse-power cannot be coped with until next stroke. In such a case with steam at cut-off for 1,000 h.p. rate at work, there would be 500 h. p. going entirely to acceleration.

It follows that for such a case we must know, or assume, the maximum and minimum loading, and, having fixed upon the speed variation which can be allowed, we must so proportion our fly-wheel weight that the maximum load variation during that portion of the stroke uncontrolled by the governor shall not set free, or absorb so much energy as to accelerate the fly-wheel beyond the allowed limit, or add to the duty of the engine more load than can be taken out of the stored energy of the fly-wheel.

For central station work, Mr. Aldrich is in favor of some kind of electro-magnetic govenor which shall act quickly upon a variation of load, and it would appear that such a governor should act by curtailing the steam supply before it would be influenced by the centrifugal governor; but even the most rapid action cannot possibly take effect after the beginning of expansion, and the problem of regulating large engines is one of the most powerful objections to their use for central station work. The power to cope with an increased load is even more difficult than that of dealing with a suddenly reduced load; for in the latter case it is quite open to us, if we do not mind wasting some of our energy, to cause the electric governor to put in action a a powerful break, but this would have no counterpart in the reverse action of sudden load increase, unless it be in some device for re-admission of steam to the cylinder after cut-off has occurred.

In respect of governing, the steam engine does not compare favorably with the turbine, either hydraulic or steam, for the turbine can be very quickly regulated, being equivalent to a steam engine of infinite reciprocation. In any station the question of engine sizes must very largely depend upon the total power to be generated if great steadiness be required, and in a station with several engines, better results may be expected than from a single engine, which may be drawn upon for the whole of the load variation.

For sudden load variation it will always be difficult to so regulate an engine as to avoid considerable departure from even mean normal speed, but for gradual changes of load the problem was solved half a century ago, in the manner described, and as has been very commonly carried out in Corliss engines, and in the Knowles supplementary governor brought out a few years ago. With these appliances the engineers of the great textile factories preserve an almost absolutely even mean speed, as evidenced by a speed recorder, and any variation in speed during each revolution in controlled by the fly-wheel inertia, With the best of governing, there must always be placed considerable reliance upon fly-wheel action, and this the small, quickly-reciprocating engines do, for their small fly-wheels have very considerable inertia relative to the stroke duration. The so-called slow running mill engines are not really slow running as regards piston speed, and many of them might with advantage be made of higher reciprocating speed and could be, were better attention given to bearing surfaces, which could be run much tighter than they are if more truly circular, for with correct valve setting, the change of direction of pressure need not be accompanied by shock, to get rid of which is one of the objects of the design of single-acting engines.—London *Electrical Review.*

CHANGES IN THE CANADIAN PATENT LAW.

IMPORTANT amendments have been lately made to the patent act of Canada by the Canadian Parliament. Some new features borrowed from the United States patent laws are noticeable, such as the employment of examiners in the Patent Office to make a thorough examination of the applicant's title to his invention. The other material changes made are noted below.

Models of inventions or specimens of compositions need now only be furnished if required by the Commissioner of Patents. The duration of a patent is to be 18 years, with a fee of $60, with the option, however, of paying partial fees of $20 and $40 for terms of 6 or 12 years.

The inventor's oath or affirmation may be made before a minister plenipotentiary, *charge d'affaires*, vice consul or consular agent, a Judge of any court, a notary public, a justice of the peace, or the mayor of any city, borough or town, or a commissioner for taking affidavits having authority or jurisdiction within the place where the oath may be administered.

Importation of the invention into Canada after 12 months from the time of granting a patent (or any extension of such period) by the patentee, his representatives or assignees for a whole or a part of his interest in the patent, renders the patent void only as to the interest of the party importing or causing to be imported.

A federal court, the Exchequer Court, is given jurisdiction not only of all questions involving the validity of a patent but also of all questions arising as to whether any intrest therein is null and void.

A citizen of Canada electing to obtain a foreign patent for an invention, before obtaining a Canadian patent, shall have the right to obtain a patent in Canada, if the same be applied for within one year of the date of issue of the first foreign patent, the inventor gives notice to the commissioner of his intention to apply for a patent in Canada, then no other person having commenced to manufacture the device in Canada during such period of one year shall be entitled to continue such manufacture after the inventor has obtained a patent in Canada, without the consent of the inventor.

SPARKS.

Nr. Hendrie, the owner, is negotiating for the sale of the St. Thomas street railway.

A brick addition is being built to the present power house of the North-West Electric Co., Winnipeg, and two additional steam boilers installed.

Mr. F. N. Gisborne, Superintendent of Government Telegraphs, and one of the most able electricians of the day, died at Ottawa on August 27th, aged seventy years.

Messrs. H. P. Dwight, the president, and G. D. Perry, the secretary of the Great Northwestern Telegraph Co.; F. H. Waycott, the manager of the Anglo-American Telegraph Co.; Wm. Wainwright and F. Roper have given notice to the Quebec Legislature of application for incorporation under the name of the Anglo-Provincial Telegraph Co., with a capital of $25,000. This company will carry on a general telegraph business in the province of Quebec, with headquarters at Montreal.

The Merchant's Telephone Co., of Montreal, has applied for incorporation with a capital of $100,000, to do a general telephone and electric business. In order to prevent the concern from being absorbed like its predecessors by the Bell company, each subscriber for a telephone must also subscribe for $100 of its stock and also agree to take his telephone for a period of five years. The rental of a telephone has been fixed at $25 per annum, and the stock of the company having been fully subscribed, will be increased largely.

Under the direction of Mr. A. B. Smith, Superintendent, the Great North Western Telegraph Co., have recently installed as part of their battery plant, a motor generator of new and novel design. The machine has been in practical use for some time past, replacing about one thousand cells of ordinary Calland battery. The officials of the company are so well pleased with the results and the great economy effected that it is the intention to discard the use of chemical batteries and adopt dynamo currents exclusively. This is the first time that telegraph companies in Canada have adopted dynamos for battery purposes, and the new departure cannot fail to be of interest to the fraternity.

FIELD MAGNETS.

THE field magnets of a dynamo electric machine, says the *Electrical Age*, constitute one of the two of its most essential parts. The other part is the armature.

The field magnets are constructed of several parts, namely, the magnet cores (of which there are usually two), the yoke piece, the pole pieces and the wire with which the magnets are wound.

The accompanying illustration shows these various parts and the manner of assembling them to make the field magnets complete.

There are many forms of dynamos in use, but the one illustrated in the diagram is in no essential respect different to all the others.

The function of the field magnets is to create and maintain a magnetic field in which the armature may revolve. As a rule, dynamos are so built that the field magnets ars stationary while the armature revolves. Some machines are made, however, with stationary armature and revolving magnets. One part *must* move ; this is manifest when we think for a moment that in order to create a difference of potential in the wire of the armature, or, in other words, generate a current, that wire must cut through the magnetic lines of force in the magnetic field. This implies motion.

The material used for the different parts of field magnets is the softest iron procurable, except in the case of the wire, which

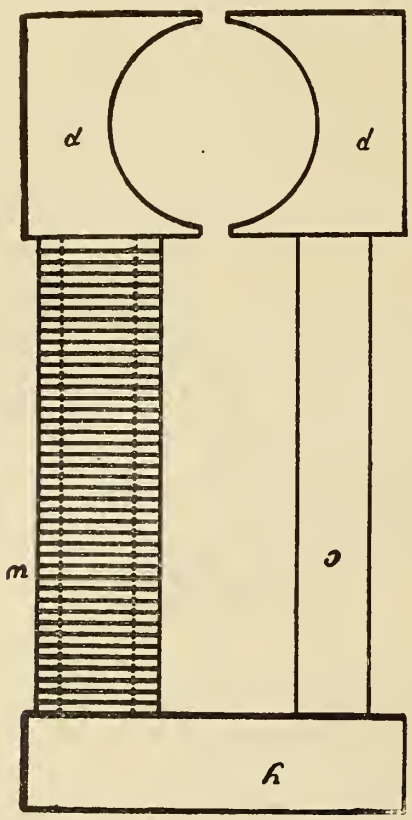


DIAGRAM OF FIELD MAGNETS
Y, Yoke. *C*, Magnet core. *W*, Magnet windings.
P, *P*, Pole pieces.

is of copper. Soft iron is used, because with it, it is possible to produce a much more powerful magnetic field than if any other quality were used. Iron is the essential metal to use always for magnets in all cases of electrical instruments on account of its high magnetic properties ; that is to say, it is the best conductor of magnetism. Metals are divided into two classes with reference to their magnetic behavior, viz: magnetic and non-magnetic. Copper is classed as a non-magnetic metal, while iron is the most magnetic ; hence the importance of iron in the construction of magnets will be readily understood.

There are as many different forms of dynamos as there are makers—no two being alike. As the field magnets usually constitute the most prominent part of dynamos, the difference in form of machines relates wholly to the shape of the field magnets, although there are structural differences in different makes of armatures as well. These, however, are not readily noticeable to the observer.

The form of dynamo illustrated in our figure requires a yoke, the function of which is to effect continuity in the magnetic circuit. Without the yoke the magnetic field surrounding the armature would be infinitely weaker, and the machine would be practically valueless. All dynamos do not possess a yoke piece ; indeed, some dynamo field magnets are constructed on the typical horseshoe form, and consequently require no yoke. The form shown in the figure is a modification of the horseshoe ; instead of the curve it has corners.

The pole pieces are really enlargements of the core, so as to increase the surface of magnetic action, and are constructed with curves on their inner surfaces, so as to cover the surface of the armature as completely as possible, and yet have a break in the continuity of the magnetic circuit.

These pole pieces are really the "poles" of the electromagnet. We all know that a horseshoe (permanent) magnet is strongest at its poles ; so in the case of a dynamo, the magnetism is strongest at the pole pieces, and as the lines flow from one pole to the other, according to the direction of the current flowing in the magnet wire, they must necessarily flow or act through the space between the pole pieces. As this place is filled with the magnetic lines of force, and as the wire on the armature must cut lines of force in order to effect a difference of potential, and consequently generate a current, the armature is placed in this space, or magnetic field, as it is usually called.

Concerning the magnetic field we will say more later on.

The core of the field magnets are generally made round. Some, however, are elliptical in shape. They are never made square or in any other form possessing points or corners, because such projections became "poles" themselves, and as it is essential to have all the magnetic influence concentrated at two points, namely, the pole pieces, the importance of adopting every means possible to convey the magnetic lines to these points is manifest ; hence the round form is adopted for magnet cores. In the case of the yoke piece the magnetism is very weak, or practically *nil* at that part of the magnetic circuit, hence the existence of the corners makes no material difference in practical results.

The magnetism is strongest between the pole pieces and weakest at the yoke.

As to the winding of the magnets, of course, that involves many factors in its calculation, and as it is not within the scope of these articles to consider indefinite problems of this nature, we refer those of our readers who desire to go into the subject further to any one of the text-books which are now published, giving all such information. An excellent book of this class is "Principles of Dynamo-Electric Machines," by Carl Hering.

Copper wire, of course, is always used for magnet windings, It is covered with some insulating material in order to keep the windings from touching one another. The copper must be of the purest quality obtainable in order to keep the resistance down to a minimum. The size of the wire is determined by calculations based on the work that will be required of the machine.

Some dynamo field magnets are wound with two coils. Such machines are known as compound-wound dynamos.

It is important to have all joints between the parts of a field magnet very secure and reliable, so as to interpose no resistance in the magnetic circuit.

TRADE NOTES.

We have received from the Ball Electric Light Co., a tastefully printed book of testimonials from users of the Ball apparatus in Canada during the last ten years, certifying in flattering terms to its efficiency.

The Royal Electric Company, of Montreal, report the following sales during the month of July: Hamilton Electric Light and Power Company; Hamilton, Ont., one 50 light 2000 candle power arc dynamo and lamps; John Starr, Son & Co., Halifax, N. S., one 50 light 1200 candle power arc dynamo and lamps ; W. S. Shaw, Huntsville, Ont., one 500 light alternating dynamo ; The T. Eaton Company, Toronto, Ont., one 7½ horse power motor and 42 arc lamps ; Hunt Bros., London, Ont., one 65 horse power generator and three tons of wire ; The Wingham Electric Light Company, Wingham, Ont., one 500 light alternating dynamo with 300 lamps and fixtures ; The Dominion Electric Company, Montreal, Que., one 7½ horse power motor ; F. X. Charbonneau. Montreal, Que., one 1½ horse power motor ; Messrs. Conlan & Levell, Montreal, Que., one 1½ horse power motor.

At the first annual meeting of the Ottawa Electric Street Railway a dividend of seven per cent. was declared.

CANADIAN ELECTRICAL ASSOCIATION.

A MEETING of the Executive Committee of the above association was held in Toronto, on the 8th of August. There were present, Messrs. J. J. Wright, (in the chair), K. J. Dunstan, John Yule, W. A. Johnston, D. Thomson, S. J. Parker, A. B. Smith and the Secretary. The accounts in connection with the holding of the Hamilton convention and the printing and distribution of the report of the same in pamphlet form, totalling about $200, were passed and ordered to be paid. The sum of $25 was also voted the Secretary-Treasurer to reimburse him for incidental expenses. The Treasurer reported that after paying all liabilities and the grant to himself, the balance to the credit of the Association would be $200. A discussion ensued as to the nature of the statistics to be collected by the Committee on Statistics appointed at the Hamilton convention. The opinion prevailed that data might be procured as to the cost of supplying electric light and power which would be valuable as a guide to those in the business. The matter was finally left to the discretion of the Committee, of which Mr. D. Thomson was appointed chairman. Reference was made to the fact that the Dominion Government has placed in the estimates an appropriation to cover preliminary expenses in connection with the establishment of a system of electric light inspection. The opinion was that there was nothing objectionable in the proposal, provided meters could be got to correctly record the results of the operation of the various kind of electric apparatus. The Committee discussed the question of a Canadian electrical exhibit at the World's Fair. It was deemed inadvisable to take action, principally for two reasons. First, no trade would be likely to accrue to Canadian manufacturers from such an exhibit. In the opinion of many, did any such possibility exist it would speedily be converted into an impossibility by an increase in the U. S. tarift. Secondly, the unfriendly spirit which the Government of the United States has of late exhibited towards Canada, has given rise to the feeling that the people of the Dominon, electrical and otherwise, should refrain from taking any part in the approaching World's Fair. So far as the electrical interests are concerned, it was thought to be more wise to make an effort to hold a creditable exhibit in connection with the Toronto Industrial Exhibition of 1893. The Secretary was instructed to have the constitution and by-laws, as revised at the recent convention, reprinted and distributed to members. The names of several peusons were mentioned who will be asked to prepare papers for the meeting of the Association in January.

A SUGGESTION.

Editor ELECTRICAL NEWS.

SIR,—I have read with interest the report of the doings at the Canadian Electrical Association convention, and think it bids fair to be a splendid institution for those interested in the financial department of electrical business. There is one thing, however, that seems to be entirely omitted—that is, the mechanical management of the business. I think there is no other business under the sun, in which the owners have to depend on their men so much as in electric lighting.

Do you not think that it would be profitable to both the proprietors and men who look after the plants, to form an association and meet in different places at stated periods. At such meetings, papers could be read, and discussed by the dynamo tenders and engineers. This, I am sure, would be of great benefit to all parties concerned. I was talking to a well-known dynamo man, a few days ago, about the matter. He said he had no interest in telephone business, and therefore would have nothing to do with the Canadian Electrical Association. The engineers have associations for the benefit of themselves, so should the dynamo men. Hoping that the matter will not drop,

I remain, yours respectfully,

A DYNAMO MAN.

[The writer of the above appears to be under a misconception regarding the character and objects of the Canadian Electrical Association. It is not designed to be an institution in the interest only of persons whose capital has been invested in electrical enterprises ; nor is it designed especially to promote the telephone interest, or, in short any sectional interest. On the contrary it is intended to be an association for the benefit of all persons in any way connected with or interested in the application of electricity to commercial or scientific uses. We cannot agree with our correspondent's statement that the mechanical management of the business was entirely omitted from the proceedings of the recent convention at Hamilton, in proof of which we are able to point to Mr. Thomson's paper on "Central Stations," Mr. J. J. Wright's paper on "Steam and Electric Power," and Mr. Fisk's paper on "Carbon Manufacture," all of which contained information of value to persons charged with the care of electric lighting apparatus. The formation of more than one Association of persons representing electrical interests in Canada, is unnecessary. There is a field for the profitable operation of one such organization, but not for more than one. If the Canadian Electrical Association is lacking in its duty to any particular interest, those who have been placed in charge of its affairs will always be pleased to have their attention called to the fact, and will use their best endeavors to make good the deficiency. Meanwhile will our correspondent or some other "dynamo man," volunteer to prepare a paper for the January meeting of the Association, which would be instructive to others of their class ? In a word, the way to make the Association of the greatest value to all is by becoming a member and then giving it the benefit of your personal ideas and effort.—Editor E. NEWS.]

CORRECTION.

Editor ELECTRICAL NEWS.

SIR,—I notice in an article on the C. A. S. E. picnic, published in your last issue, that Ryrie Bros. are said to have given the first-prize in the ladies' race. This is a mistake. Robin & Sadler, belt manufacturers, of Montreal, gave the very handsome card receiver which was given as first prize in the ladies' race ; it was given by the Toronto agency of the firm, to whom I think a correction is due.

E. J. PHILLIPS,
Rec. Sec. C. A. S. E.

"THE FOREST CITY" LIGHTING STATION.

Editor ELECTRICAL NEWS.

DEAR SIR : While in London a short time ago, I visited the Forest City Electric Light plant, owned by Messsrs. Hunt Bros. The plant is a frame building situated at the back of the flouring mill, of which Hunt Bros. are also the owners. The dynamo room is 30 × 40, the engine room is also 30 × 40, the boiler room 20 × 40, with a fine brick stack. There are seven dynamos of the T. & H. system, built by the Royal Electric Co., of Montreal, of the following dimensions : Four 40 lt. 2,000 c.p. ; one 10 lt. 2,000 c.p. ; and two 20 lt. 2,000 c.p.

These machines are wired to a Royal switch board, by the manipulation of which the load can be changed from one machine to another at a moment's notice. Their usual load is 180 2,000 c.p. arc lamps, 87 of which are private lights, the remaining 93 being city street lights. There is also in the dynamo room a nice screw cutting lathe, for making necessary repairs.

The motive power, in addition to water wheels, is supplied by a 150 h.p. and a 65 h.p. Leonard Ball high speed engines, supplied with steam from two large steel boilers. There is a good water power also, but not enough of it for both the mill and the lighting station.

Power is transmitted from the engines to a countershaft which is fitted with Waterous clutch pulleys, and in the centre of the shaft is a Waterous coupling, so as to allow one-half the plant to be run by steam and the other by water, whenever desirable.

The circuits consist of about 40 miles of No. 6 B. & S. wire. The firm are, at the present time, figuring on putting in a power generator for supplying customers all over the city. The lights are giving the best of satisfaction, notwithstanding the fact that no night inspectors are employed.

The electrical part is looked after by Mr. R. A. Lyons, while the steam engineering is under the supervision of Mr. R. Shapland and his assistant. Everything around this station, in both departments, is kept in good order, and reflects credit on the men in charge.

Yours truly,

TRAMP.

The machinery in the agricultural implement department of the Montreal industrial exhibition will be operated by electric motors.

The Consolidated Electric Co., of St. John, N. B., is constructing a new building to accommodate more engines and other machinery, and provide room for the balance of the machinery now at the old station of the New Brunswick company, and the new street railway generator.

CANADIAN ELECTRICAL NEWS AND STEAM ENGINEERING JOURNAL

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Subscribers may have the mailing address changed as often as desired. *When ordering change, always give the old as well as the new address.*

The Publisher should be notified of the failure of subscribers to receive their papers promptly and regularly.

EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

THE "CANADIAN ELECTRICAL NEWS" HAS BEEN APPOINTED THE OFFICIAL PAPER OF THE CANADIAN ELECTRICAL ASSOCIATION.

CANADIAN ELECTRICAL ASSOCIATION.

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NOTICE OF REMOVAL.

On or about the 20th of September, the publication offices of the ELECTRICAL NEWS will be removed to the new Confederation Life Association Building, corner of Yonge and Richmond Streets, Toronto.

NEGOTIATIONS are understood to be in progress for the purchase of the Edison works at Peterborough, Ont., by the Toronto Construction and Electrical Supply Company. In the event of the bargain taking place, the intention is to largely increase the capital stock of the purchasing company.

THE new electric railway and the first industrial exhibition went into operation at Winnipeg almost simultaneously, and both proved to be remarkable successes. The railway carried thousands to the Fair grounds. The trip was made in fifteen minutes, or at the rate of seven miles an hour. With a Westinghouse car a trial trip was made at a speed of 27 miles an hour.

THE City of Brantford will try the experiment of owning and operating its own electric lighting plant and street railway system. The results will be watched with interest. The Chairman of the Fire and Light Committie of Toronto Junction, which has been doing its own lighting, could, it is said, "a tale unfold" which should cause other municipalities to hesitate about moving in this direction. The cost of electric lighting in Toronto Junction under municipal control is currently reported to be about three times what would be paid under contract with a private company. Since the above was put in type, the ratepayers of Brantford have refused to vote the money for purchase of plant.

THE manager of an electric light company which has found it necessary to increase its motive power, writes us for advice as to the best kind of engine to purchase. We have referred him to our advertisers who manufacture engines specially adapted for central station work. In view of the demand for engines for this purpose it is singular that more engine builders do not seek to make the acquaintance of our readers. We may be permitted to remark for the benefit of some who do not appear to be aware of the fact, that an electrical paper is the best place to advertise engines or anything else required by electrical people.

THERE is an old white horse connected with the Toronto Electric Light Company's station, whose eccentricities have been the subject of much amusement to everybody around the establishment. He has been employed for two or three years past in hauling the ashes away from the boiler house. This work he performs with the utmost willingness six days of every week, but no amount of persuasion will induce him to work on Sunday. From whence he imbibed his strict Sabbatarian views is unknown to his present owners, who cannot but admire, however, the consistency with which he adheres to his principles. Another of his peculiarities is his objection to do any work or go anywhere outside of the station yard. He manifests this objection by falling down in utter helplessness whenever he is put to do any outside work, notwithstanding when at his usual employment he has never been known to fall.

UNTIL a few weeks ago the Montreal street railway was one of the worst managed concerns of its kind on the continent. The cars were dirty and uncomfortable, and were run with the greatest irregularity. The company issued no tickets, and had no provision for transfers. All this has been changed as if by magic, by the company which has lately assumed charge of the road. The citizens are said to be delighted with the change, and are showing their appreciation by using the cars to a much greater extent than formerly. Indeed, we have been told that on the first day that tickets were issued, the receipts were more than double what they had previously been. The road being owned by the Everett-McKenzie syndicate which controls the Toronto street railway, is being operated on the same basis as the latter—viz., six tickets are sold for a quarter, and eight for a quarter good for use from five to eight o'clock a.m. and from five to 6:30 p.m. The Royal Electric Co. has been given the contract for the equipment of upwards of seventy electric cars for use on this road, which, simultaneously with the Toronto

system, is being converted to electricity as rapidly as it is possible for the work to be done. The order for the equipment of the Toronto system has been placed with the Edison Co. It is understood that in Montreal a new motor designed by Mr. Fred. Thomson, of the Royal Electric Co., is to be used.

ELECTRIC street cars have commenced running in Toronto, and the trolley system will soon be in general use in the city. Many people are much alarmed and fear that fatal accidents will be common. It would be well for all concerned to act upon the advice given by one of our American engineering papers on this subject, "Don't meddle with what is none of your business, if you do not understand the peculiarities of the device." The trolley cars are intended for the public to ride on, and nothing more. The public should be careful about getting on and off the cars, and do so only when the cars are stopped. Most of the accidents have occurred through neglect of this very simple rule. The electric cars are usually run much faster than the horse cars, and it takes time and experience before one can properly judge the speed at which it would be quite safe to get on or off a moving electric car, hence it is safer to wait till it has stopped.

BOURNE, in his treatise on the steam engine, introduces the subject of "Boilers," by saying : "A disquisition on the subject of boilers naturally begins with the subject of furnaces, for although furnaces may exist without a boiler, a boiler will be of little utility without a furnace." That was written over thirty years ago, and is still true, only some in our time advocate that the consideration of what is requisite for a steam boiler should begin not with a furnace, but with a man. Of what use, say they, will either boiler or furnace be, unless a proper man be placed in charge. The Canadian Stationary Engineers' Association is doing good work in this country, in the way of training men to take charge of boilers, furnaces and engines. Owners of steam machinery should aid the Association in its laudable efforts. They can do this, by insisting that the men employed by them to manage their steam plant, should hold certificates of competency from the Association. The Executive Council of the Association met in Hamilton on 30th August, for the election of officers for the ensuing year and for the discussion of matters affecting the interests of the Association. Papers were read on steam boilers, the qualifications of engineer, and kindred subjects.

THERE was a prospect at one time that Canada would be largely represented at the Columbian Exposition, but circumstances alter cases. The American government has passed an Act by which the President is authorized to impose burdens and annoyance upon the trade of this country, until such time as the Dominion shall be able to perfect her canal system and be independent of her neighbor. This attempt on the part of a great and powerful nation to check our development, has naturally chilled the friendly feelings with which heretofore we regarded the Republic. In consequence some of our largest manufacturers whose intention was to send large exhibits to Chicago next year, now declare that they have withdrawn altogether from the undertaking. Reference is made elsewhere to the fact that no action is likely to be taken by the Canadian Electrical Association toward securing an exhibit by Canadian electrical manufactures. In addition to the unfriendly attitude assumed by the United States toward the Dominion, there is the important consideration that the American tariff makes it impossible for any business to be done by our manufacturers across the line. An instance of this came to our notice the other day wherein the Brooks Manufacturing Co. of Peterborough received an order from the States for 20,000 carbons, but in the face of a 55 per cent. duty were unable to fill it.

THE new electric street railway at Hamilton, like a fractious young horse under the process of being subdued to harness, seems determined to exercise the privilege of kicking up its heels occasionally before settling down to the sober work of life. As a consequence there have been two or three collisions with street vehicles, in which, as a rule, the latter came out second best. An exception to the rule, however, was one day met with in the driver of a watering cart, who, while leisurely crossing the street, smiled defiance at the threats of the motorneer to enforce the right of way. On one occasion the James St. car failed to take the switch at the corner of James and King streets, but kept straight on up James street. A short distance in front was seen the dummy engine and a train of cars belonging to the Dundas railway crossing the streets. So frightened did the motorneer and conductor become, in view of the seemingly impending collision, that the former jerked the handle off the rheostat, while it never occurred to the latter to shut off the current by breaking contact between the trolley and the wire. The passengers, taking in the situation, jumped from the car, and drawing themselves up in line on either side of the street, watched with interest the termination of the episode. Fortunately the Dundas train cleared the crossing ahead of the arrival of the electric car, while the motorneer and conductor, having recovered their presence of mind, again secured the control.

THE proceedings of the convention of the Canadian Electrical Association at Hamilton have been printed in pamphlet form, and distributed to all persons known to be interested in electricity. If there are any such who have not received a copy, they may obtain one free of cost on application to the Secretary. It is the subject of regret that the report is not as full or as accurate as could be desired, for reasons which need not here be stated, but which were beyond the power of the officers to remedy. Care will be taken to secure verbatim reports of future conventions, which reports will probably be sent to members only. Speaking of future conventions, we are reminded that preparations must soon be commenced for the meeting to be held in Toronto in January. Some line papers are required, calculated to instruct the members engaged in the various departments of electrical work, and provoke valuable discussion. It would please the Executive Committee very much if some of the members, without waiting to be pressed into service, would volunteer to prepare papers for the occasion. The Committee would also welcome any suggestions calculated to impart to the Conventions of the Association the greatest possible interest, or add to the usefulness of the Association in any way. We will gladly place the columns of the ELECTRICAL NEWS at the disposal of members who may have suggestions of any kind to offer for the welfare of the Association. Suggestions are also invited touching desirable amendments to the constitution and by-laws, the revision of which was delegated to a committee by the Hamilton meeting. The first convention is admitted to have been a success, and if every member feels that there is individual responsibility resting upon him to help on the work of the organization, the conventions of the future should be occasions of ever increasing interest.

WE cannot too forcibly impress upon owners and managers of existing electric light companies, and particularly those who have municipal lighting contracts to fulfil, the importance of keeping their service up to a fixed standard at all times, thereby giving the interested parties such a degree of satisfaction that when the time comes for a new contract to be made, they will be the ones to secure it against other competitors, even though their figures should be a trifle higher. Good service will also tend to render unpopular the idea of municipalities attempting to operate their own lighting plants. It is infinitely better in every way for cities to have their lighting done by a company or individuals than attempt to do it themselves. It is a well recognized fact that where towns and cities have tried the experiment, it has always turned out a dismal failure, costing them in some instances fully 50 per cent. more than if they had let the contract to others. There has come under the writer's observation within a very short period, an instance in which a company was supplying so called 2000 candle power arc lights and with but a 7½ ampere current, and in which one or more lights went out after starting time, and could not be made to go again. There was no provision for changing such lights ; they were allowed to remain unlighted until next day, when the lamp instead of being brought in and put in good order again, was in most cases patched up in its place on the pole, no attention apparently being paid to the fact that the company's contract with the city called for good and efficient service at all times. Then, as if to make the aldermen and citizens generally see how poorly the wires and lamps could be constructed, the center of the municipality seemed to have been the part selected for one of

the poorest jobs of line construction that we have chanced to see for a long time. It is not to be wondered at, that this municipality is considering the advisability of doing its own lighting. In face of the fact that the authorities must be reasonably sure that they cannot operate the light at as low a figure as the existing company tenders for them, they seem positively assured that they will be able to give decidedly better lighting than at present. True, the company promise to put in new apparatus and new lamps and fix things up generally, but public feeling seems to resemble that of the burnt child who dreads the fire. All this but emphazises the remark in the first part of this article that it is for the welfare of any company supplying electricity for commercial purposes to endeavor to give the best possible service to their customers, both as to quality of light and keeping their outside plant in good order, thereby preventing the dissatisfaction which is bound to prevail if these important points are neglected.

THERE seems to be contemplated some legislative action in the Dominion parliament to fix upon a method of inspecting and testing the supply of current of electric lighting, and also of making disinterested tests of meters. This has no doubt been brought about through the influence of the gas companies, who it is well known must submit their meters and gas to government inspection at stated intervals. While we see no objection the testing system, yet the circumstances, compared with gas, are so different, that there will be special requirements in making such tests to make inspection a benefit to the company supplying the light as well as to the consumer, which, of course, should be the purpose of the contemplated enactment. It is of as much interest to the supplier as to the supplied to know that payment is made for the exact amount of current consumed, and that a revenue is coming in for every ampere of current that is produced at the machine. The point of most importance will be to determine by what standard the present meters should be tested. Gas being supplied from a tank, the meter will not change in its registering should the pressure run up or down beyond a normal or fixed point. The reverse is the case with the electric meter. A gas meter being composed of a pair of bellows whose capacity is just so much, no matter whether the gas pressure be high or low, will just register each bellows full that passes through it. Electric meters on the contrary are built for a certain fixed pressure or voltage, and do not register properly if this voltage is increased or decreased, the ratio being far in excess of the slight drop or rise in the voltage. True this could all be arranged by the government insisting on a fixed or standard voltage, but the question would then arise, who is to pay for the alterations in converters and lamps needed to suit what in a great many cases would be a change from existing methods? With reference to the candle power of lamps it would probably be found difficult to fix upon a better ratio of current than that which was submitted at the first convention of the Canadian Electrical Association, a few months ago, and which was left over until the next convention for further consideration; viz., "That when the carbons in an arc lamp are the proper distance apart, to give their maximum amount of light without either flaming or frying, that the strength or current for a 2000 (nominal) candle power arc shall not be less than 9½ amperes; for a 1600 (nominal) c. p. arc not less than 8 amperes; for a 1200 (nominal) c.p. arc not less than 6 amperes, and for an 800 (nominal) c.p. arc not less than 4 amperes." It is, of course, possible to make a photometric test of an arc light, but we question whether such test is absolutely accurate, and think the most advisable course to pursue would be to fix a standard of current, and if the carbons are as they should be and the lamp well adjusted, such standard current will give the same amount of light in every case. It is entirely different with incandescent lights, in the case of which the photometer can be used to advantage, and will no doubt measure the light given out very accurately. Even here, however, it would be well to establish a fixed number of watts per candle, and we would suggest that a suitable standard for incandescent lights would be 3½ watts per candle.

In return for an exclusive franchise the Bell Telephone Co. is said to have offered to pay the city of London $800 per year and keep free of charge for the use of the city fire alarm wire the top cross-arm of every pole to be erected.

OIL AS FUEL FOR BOILERS.

SOME time ago a proposition was made to use oil as fuel under the steam boilers at the pumping station of the Toronto water works. The proposal was made, with the hope that the use of oil would prove a deliverance from the power of combination in the coal business. Up to the present time, we understand, nothing has been done in the matter.

If it were possible to have the furnaces arranged so that either coal or oil could be used, then fair competition might be obtained, and fuel secured at a reasonable price. Here is a problem well worthy of the attention of the skilled men who are engaged about steam boilers and furnaces.

Many attempts have been made to produce such a furnace, but as yet none have come into practical use, and there is a good opening for such a contrivance.

Oil is used as fuel for steam boilers in Russia, where petroleum is found in large quantities. It is used in locomotives on the railways, and in the Caspian sea the steamboats use it instead of coal.

The furnaces require to be of special construction, the main difficulty being in getting the oil broken up into small particles and mixed with a proper quantity of air, and at the same time having the temperature high enough to support combustion.

In some of the furnaces an arrangement of brickwork is made, something like a small oven, with openings through part of the walls for the escape of the heated gases or flame. Into this brick oven the oil is blown in the form of spray by means of a steam jet.

The Russian locomotives use this form of furnace, the brick oven taking the place of grate bars and the usual fire brick bridge wall. Air has to be admitted, and between the usual jet in the smoke pipe and the jet forcing in the oil, a very strong draught can be maintained.

In England experiments have been made in using oil as fuel for locomotives. One method tried with considerable success, is to retain the grate bars and burn a thin coal fire on the bars. Chalk is thrown over the fire, and oil injected in a spray by means of a steam jet.

In Chicago, and the west, oil is used in many places, but in all we have been able to get information about special furnaces and steam jets are required.

Oil can be used successfully, and it is only a question of the relative price of coal and oil as to which is the cheaper. One advantage that oil has is, that self-feeding apparatus can easily be applied, and as there are no ashes to remove, there is a saving in labour, and in some cases the number of men employed may be reduced.

QUESTIONS AND ANSWERS.

AN electric lighting company in Ontario write: "Kindly give estimated cost of steam power each arc light per night."

ANS.—We cannot give you price of steam power per light, having no data, and furthermore cannot obtain it. The number of lights is not alike, in most instances, two nights in succession. It altogether depends on the number of lights burning, as it is manifest that one engineer could attend to an engine running 200 as easily as one running 50 lights. Where consumption of fuel also includes day running for power and steam for heating, the different services overlap so that they cannot be separated. The price would vary under different conditions in any place, and no two are alike—for instance, cost of fuel, number of lights, amperes of current, hours of burning, variety of engine, whether high pressure or condensing.

PERSONAL.

Mr. Sylvester Potter has been placed in charge of the steam plant at the Hamilton Street Railway power house.

Messrs. John Carroll, Secretary-Treasurer of the Eugene Phillips Electrical Works, and Chas. W. Hagar, manager of the Royal Electric Co., Montreal, were present at the annual clam-bake given by Mr. Eugene Philips at Providence, R. I., in July. Mr. Hagar is credited with having made an excellent speech.

Mr. W. E. Davis, formerly mechanical and electrical superintendent for the Toronto Incandescent Electric Light Co., has accepted the position of Superintendent of the Toronto Street Railway Co. He will have supervision of the employees of the company, and of the supplies and equipment in connection with the entire system.

ELECTRICAL LESSONS FOR MACHINISTS AND ENGINEERS.

Since our last issue, it has occurred to us that it would be better, before going further into the details of the construction of dynamos and motors as intended, to give a few of the most important points and facts relative to planning, running and manufacturing them.

There are many faults liable to arise which, although apparently trifling in themselves at first, may at any moment, if neglected, result seriously and perhaps in the complete destruction of the machine.

We will direct your attention to some of the most common faults, and explain how best to remove them, and how by ordinary case they may be avoided altogether.

The sparking at the brushes, a very common fault, may be due to any one of several causes, such as bad contact between brushes and commutator, by reason of the brushes pressing too heavily or too lightly or unevenly on the commutator, or through bad adjustment, or the parts being over-heated or worn away. The proper position and pressure of the brushes on the commutator can best be found by shifting them until the least sparking and best results are obtained. When the brushes become worn away unevenly they should be turned over, or the ends should be trimmed off evenly.

The commutator should be frequently oiled to prevent undue wear and friction, which means heating, and heating is a very objectionable fault. The oil, however, must be of good quality and very sparingly applied, as otherwise it will introduce resistance, sparking and, perhaps, open the circuit.

Bad adjustment of the brushes means loss of current on the outside circuit, and consequently a diminished light.

The slipping of the driving belt is a thing of too frequent occurrence in small electric plants ; it is due to one or the other of several causes. In some instances it may be remedied by using a long and broad belt, a little tighter than used for ordinary work.

The perfect insulation of all wires is one of the most important facts to be remembered. A very trifling leak from one wire to another may instantly terminate in the destruction of the machine, so far as wiring is concerned. For this reason too much care cannot be taken in insulating the wires from each other and from every other part of the machine.

The contact or short circuiting of the wires or a contact between wires and pole pieces may, by dividing the current, act in such a way as to cause the machine to give but a fractional part of the energy it otherwise would do. The careful insulation of the wires forming the circuit is a point to be carefully watched ; use no bare wires and avoid the use of metal staples in fastening against walls, etc., but use in place thereof fiber staples, or, better still, wood clamps or cleats.

The most troublesome faults in any and every electric installation, whatever its application, is bad joints. Joints that are loose, unless well soldered, often times do not make metallic contact and at other times they do, yet so far as can be judged by the eye they may appear to make perfect contact. Therefore it is wise to make a practice of always soldering joints and to make sure that the solder flows freely. To show the necessity of practicing the utmost care in joining wires, we will digress a little to relate a troublesome fault which occurred on a telegraph wire while under the supervision of the writer. An intermittent fault showed itself on a wire which was bringing in from $200 to $300 per hour. The fault appeared for a few minutes a time only, but several a day and frequently about the same hours. The line was carefully tested and appeared perfect in every way, the only difference to be detected was a very slight one in the metallic resistance which was slightly higher than when the line was first erected. The wire was partly overhead and partly underground and passed through a railroad tunnel which was about one mile long. After a long and careful search, for the fault would not show itself when we were watching and thereby enable us to locate it, we discovered the fault in a joint where the wire was carried through the railroad tunnel. The vibration due to some of the trains passing the point was often sufficient to break the metallic contact at the joint and the vibrations from the next train would probably bring the wires together again, or they would come together through some other cause. Our readers can not begin to imagine the annoyance and trouble such a fault will cause on a telegraph circuit. On any electrical circuit such a fault will give endless trouble so long as it exists. As a precaution do not neglect to solder your joints well. Rubber tape is generally used to cover the joints after soldering to insulate them.

The wires used in the construction of dynamo and for connecting dynamos and lamps, etc., should be of the very best quality of copper and leads should be of a gauge large enough not to become heated or offer much resistance. A No. 14 B.W. G. will do for one or two lamps on a short line. A high resistance wire means loss of electric energy, as the electric is converted into heat energy in the wires. The heating of the wires indicates that they are not heavy enough to do the work they are taxed with. Wires should on no account be fastened against damp walls.

The dynamo should be set upon a solid and level foundation, preferably on an adjustable wood bed, so that the whole can be readily moved to tighten or adjust the belt as required. On both dynamos and motors always use sight-feed lubricators.

Do not start a dynamo until you have satisfied yourself that everything is in a perfect order and adjustment. The dynamo, if required for arc lighting, should be series wound, and if for incandescent lighting it should be shunt wound.

The wire for the arc light circuit should be in one continuous loop. Then to connect a lamp at any point it will simply be necessary to sever the wire and connect the ends to the terminal or binding post on the lamps.

The wire for the incandescent circuits should be severed in the centre of loop and the wires fixed parallel to each other, one or two inches apart. The lamps should be connected so as to bridge across from one wire to the other.—*Scientific Machinist.*

STEAM AND EXHAUST PIPES.

THE question often arises in the mind of the engineer, says the Boston *Journal of Commerce*, as to whether his steam pipes and steam ports are large enough. It is pretty evident that there is a limit below which it is a great mistake to have the sizes of steam pipes come. An engine moving very fast must have very much larger pipes than one moving slower, and where the diameter of the cylinder is increased the size of the pipe to supply it should also be increased. A mistake is also made in allowing a six-inch pipe to answer for a seven-inch pipe, with the idea that it is only an inch larger and cannot make much difference. A six-inch pipe has an area of 28.27 square inches, and a seven-inch pipe an area of 38.48 square inches, a difference of nearly 40 per cent. which does make a difference, even though the diameters are only an inch apart. It pays to look into this matter, for a pipe too small is usually much too small.

The area of a steam port should be such that the steam will not be required to flow faster than at the rate of 100 feet per second. The method of finding this area is as follows : It is first necessary to find the volume that the steam must fill. This will, of course, be the area of the piston times the length of stroke. Thus a 20-inch cylinder, having an area of piston of 2.18 square feet, and a stroke of 5 feet, must give a volume to be filled by the steam at each stroke of $2.18 \times 5 = 10.90$ square feet. It makes no difference about the cut off ; the cylinder must be filled at this rate, whether the cut off be long or short. Suppose the engine to be making 64 revolutions per minute, which is 128 strokes. This would be $128 \div 60 = 2.13$ strokes per second, hence the port must be large enough that in every second $10.9 \times 2.13 = 23.217$ cubic feet of steam can pass through it, and in passing through it not move at a greater speed than 100 feet a second. To find the proper size of port, then all there is to do is to resolve this 23.217 cubic feet into a block 100 feet long. Dividing, then, 23.217 by 100, we have .23217 square feet as the area of the port, or 33.43 square inches.

This is the explanation of the matter. The rule is as follows : Multiply together the area of the piston in square feet and the piston speed in feet per minute, and divide product by 6000. Quotient is proper area of port in square feet. Multiply by 144 to get square inches. Steam pipes are usually made slightly smaller in area than these where the piston speed is below 400 feet per minute, but above this should be of same size. Exhaust ports and pipes should be made at least 25 per cent. larger than the steam pipe, since they must discharge all the steam that enters the cylinder in the period of admission, in the very short time when the engine is turning the centre.

SAFETY VALVES—THEIR HISTORY, ANTECEDENTS, INVENTION AND CALCULATION.

By William Barnet le Van.

(Continued from August Number.)

Hugo Bilgram, mechanical engineer, of Philadelphia, makes the following explanation of the cause of that remarkable phenomenon: His investigation revealed the fact that the current *a b*, Fig. 63, instead of leaving the ball in the line *b c*, as might be expected, follows the curvature of the ball

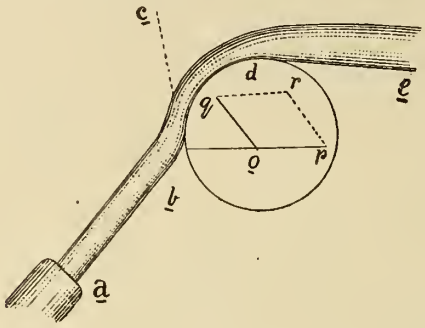


Fig. 63.

along the line *b d*, and at length leaves the ball in the line *d e*. A light ball when placed in the jet, is struck nearly centrally (see Fig. 64), the current envelops the whole ball and unites again, leaving the ball in the line *d e*, appearing as though the current was passing through the ball. It can however, easily be found that the upper branch of the current is stronger than the lower one.

By a series of subsequent experiments, it was found that any current of

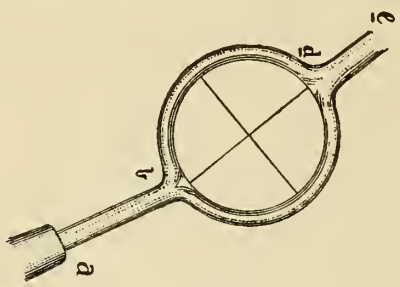


Fig. 64.

air striking a convex surface, has the tendency to follow that surface. One of these experiments is as follows: Attach to one end of a small tube, about ⅛ inch to ¼ inch diameter, and 4 to 6 inches long (which may be made by rolling up a piece of writing paper), a piece of thread or yarn about 4 to 5 inches long. Blow through the other end of this tube and direct the current against an object with a convex surface. The thread, following the current

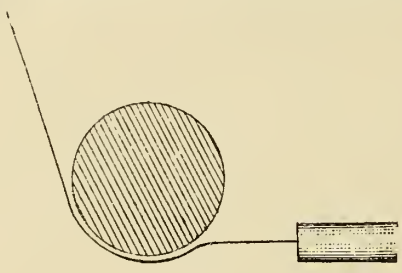


Fig. 65.

will indicate a deflection as shown in Fig. 65. After demonstrating this fact, the next step was to find its cause. It is well known that any current tends to carry along with it the surrounding particles of air; hence, the supposed currents *b c*, Fig. 63, being freely supplied with air from the left side only, will create a rarefaction of air in the angle *c b d*. It is thus exposed to a one-sided pressure, and will therefore, be deflected, as mentioned, and fol-

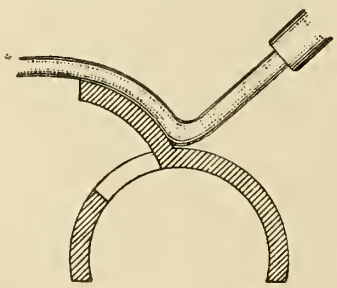


Fig. 66.

low the curvature of the surface until it meets a counter-current sufficiently strong to prevent a further rarefaction. If this view can be substantiated, it is plain that two external forces are acting upon the ball. One, the impact of the air current at *b*, transmitted at right angles to the surface, acts radially, and can be represented by the line *o p*. The other force, *o q*, is occasioned by the surplus pressure of the atmosphere on the lower side of the ball, over that of the rarefied zone under the curved current, and, combined with *o p*, it forms the vertical resultant *o r*, by which the weight of the ball is sustained. The rarefaction of air under the deflection current can be proved by the following experiments: Cut a small hole, say ½ inch square, in a piece of cardboard, fasten over this hole a cover of the same material, by means of a strip of thin paper and mucilage, to form a valve, and bend both the card and the valve into cylindrical form. If, now, a current of air is directed against the card, as shown in Fig. 66, the valve will open wide, showing the pressure under it to be greater than that above it. Or, take a strip of ordinary paper, about 1 to 2 inches wide, lay it over a cylindrical surface, and blow against it in a nearly tangential direction. The end of the strip will then rise as shown in Fig. 67.

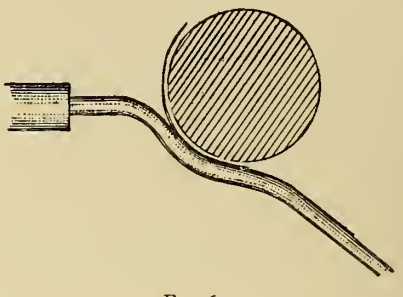


Fig. 67.

Quite a number of other experiments might be mentioned, proving the same facts. The rotation of the ball is produced by the friction of the air currents passing over the ball, and is, therefore, a secondary result.

The phenomenon of deflection of a current when striking a convex surface can be brought to bear on geographical and meteorological facts. The Gulf Stream follows the curved shore of the United States, for the identical reason that the aërial current follows the shape of a cylinder or a globe, and takes a course which otherwise it would not take. When a current of the higher strata of the atmosphere strikes the peak of a mountain, it will be deflected, follow the sides of the mountain, and will sweep the valley.

A TREACHEROUS SAFETY-VALVE.

Boilers are often operated without a steam gauge, depending on the safety valve only, to show the maximum steam pressure, a practice which should not be allowed under any circumstances. W. F. Durfee relates the following circumstances which came under his experience, which shows the dangerous practice of using boilers with *one* safety valve only, also the hidden danger which may exist in an apparently reliable safety valve.

Mr. Durfee says: About twenty years ago, during the progress of some constructions then under my supervision, I procured a second-hand portable boiler for temporary use. This boiler was provided with a safety valve whose lever was graduated to 120 pounds, and three gauge cocks, but had neither pressure guage nor glass water gauge, and, as the boiler was to be used but a short time, I did not think it necessary to furnish it with the two last-named fixtures.

The boiler was placed in the care of a steady going son of Erin, whom we will call John, with instructions to leave the safety valve weight on the 60-pound notch; to keep two gauges of water; to keep the steam as near 60 pounds as possible, and to report at once any trouble which occurred. John took a lively and attentive interest in his duties, and everything went well with him and the boiler for several weeks. But one day I was surprised by his sudden appearance, with every limb and feature indicative of extreme terror. As soon as he was able to speak, he exclaimed:

"The divil's got in the boiler, Mr. Durfee!"

"What do you mean, John?" said I.

"The divil's got in the boiler, I tell ye; fur the weight's on the ind av the liver, an' is up in the air as high's it can git; an' the divil a mite iv stame's comin' out!"

"Well," I replied, "We will go down and see if we can get the 'divil' out."

On reaching the boiler I was surprised to find the valve weight at the 120-pound notch, and that it *was* as high as it could "git" (Fig. 69), and, to my utter astonishment, there was but a suggestion of steam escaping. My first thought was that in all probability I was in the immediate vicinity of a boiler explosion; however, there was nothing to do but to ascertain the cause of the existing conditions, and therefore I immediately tried the gauge cocks, found two full guages of water, and, from the appearance of the steam which escaped on opening the upper cock, it did not seem possible that there was 120 pounds pressure upon the boiler. I then took a fire-hook, and without much effort, pulled the safety-valve lever down, but on releasing the hook it slowly returned to its former position, and at no point of its movement was there any increase of the very small and feeble volume of steam escaping. I repeated this experiment with the same result, and then began to think that John's diagnosis was correct; the boiler certainly seemed to be "possessed of the devil." Just how he got in, and how he produced the observed effects, I could not imagine; my previous practical experience with steam machinery, which I had been in the habit of regarding as embracing every species of "pure cussedness" that steam generators were heir to, did not furnish any clue to the mystery—for mystery it certainly appeared, and one which required prompt and decisive action for its solution. I therefore ordered John to draw the fire as quickly as possible, and and to report to me when the boiler was cold enough for men to dismount

the valve. In due time this was accomplished, and the state of facts disclosed is represented in the accompanying cuts (Figs. 68 and 69), which show the interior of the valve before and after it became "possessed of the devil" of deadly danger. The engravings so clearly exhibit the details of the valve and the relative position of its several parts that very little explanation is

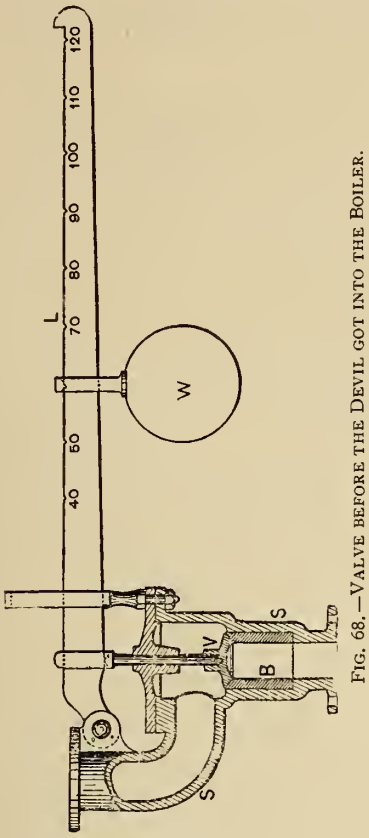


FIG. 68.—VALVE BEFORE THE DEVIL GOT INTO THE BOILER.

necessary, and it will suffice to say that the shell S of the valve was of cast iron, bored out to receive a cylindrical gun-metal bushing, B, which was forced into its place and held there simply by friction. On the upper end of this bushing and sit for the valve V was formed. As long as the bushing B remained immovable the steam pressure acted on a circular area of the lower surface of the valve V, having a diameter equal to that of the *interior* of the bushing B, but as soon as the repeated expansions and contractions

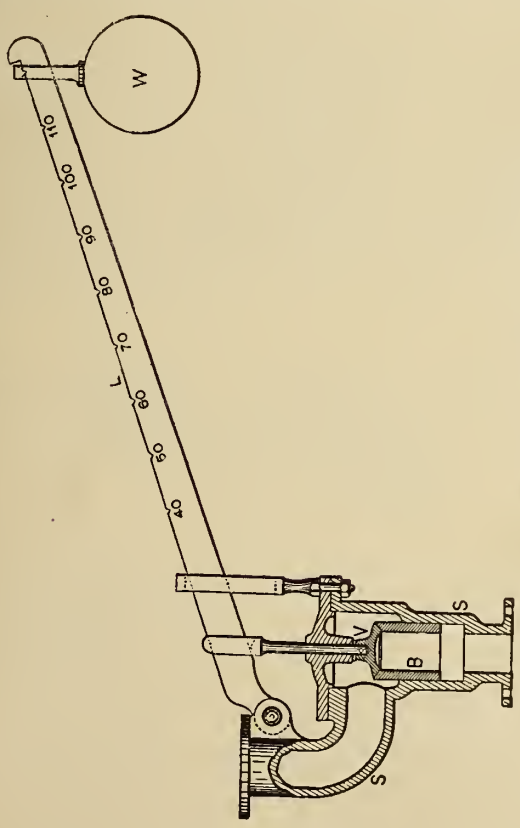


FIG. 69.—VALVE AFTER THE DEVIL GOT INTO THE BOILER.

incident to use and years had loosened the bushing B the circular area upon which the steam acted had a diameter equal to the *exterior* of the bushing B, which, with the valve V resting upon it, was then free to move upward (see Fig. 69) as far as the lever L would permit, acting simply as a piston valve—or, rather, piston—with no outlet for the steam save that due to the trifling leakage arising from its imperfect fit in the shell S. The area of the last named circle was a little more than *double* that of the first.

John's procedure before he reported the presence ot the "divil" in the boiler, was as follows: Observing the lever L in the position indicated in Fig. 68, when the weight W was at the 60 pound notch, and desiring to ascertain what pressure there was on the boiler, he commenced moving the weight W outward, the pressure of his fear augmenting as he moved the weight from notch to notch until the end of the lever was reached, and then the dynamic valve of his terror was sufficient to send him flying to me as fast as his quaking legs could carry him. It is not uncommon for the coroner's jury, while attempting to ascertain the cause of some disastrous boiler explosion, to be told by the confident witness (he is always on hand in strong force on such occasions) that "the safety valves were all right, as they had been examined but an hour before the explosion occurred." Such evidence in the case of a safety valve like the one I have described would be of no value whatever, as the fact of its being in good order when examined would be no assurance that within the next five minutes it would not be worse than no safety valve at all. It is extremely probable that there are many such safety valves in use to-day, and also that valves of such construction have been the cause of many unexplained explosions.

HINTS TO ENGINEERS.

A person who is to take charge of a boiler should make himself familiar with all the needs or defects of it, says Edwin Woodward in the *Scientific Machinist.* In the first place its strength should be known, and this is best found by a force pump, warm water—cold water pressure is injurious—and a test gauge, or a steam gauge known to be correct, and the test made at least 20 per cent. greater than the maximum steam pressure to be used. Knowing the boiler to be strong enough, the next step is to examine the pump, which should be in perfect working order. Having absolute evidence that the pump can supply, the business of supplying is a mere matter of routine, but a pump that will sometimes work and sometimes will not, is eligible for the most rigid and instantaneous examination. It may fail when its work is most important. Granted motion to the piston or plunger, a pump fails because it leaks. There can be no other reason, and the leak should be found and repaired. Leaky valves are common and should be ground. Leaky pistons are not so common, but sometimes occur. Repairing is the remedy. Leaky plungers are common. They need returning. The rod must be straight as far as in contact with the packing. The packing around the plungers is sometimes neglected too long, gets filled with dirt and sediment, and hardens and scores an otherwise perfect rod, and so leaks.

The stuffing-box should have a generous allowance of hemp—not drawn tightly around the rod, but the box well filled, and the gland screwed down tight enough to prevent a leak. Too tight only ruins the elasticity of the packing, and causes undue friction. The suction pipe should be also looked to. It is usually the source of exasperating leaks. It is usually made up of poorly-fitted nipples, elbows, couplings, and to complete the train of evils, a globe valve without any gland, and poorly packed. Freezing weather often opens the weld at the top of the water, or, in some water-pocket not properly drained. Any of these causes will destroy the efficiency of a pump, and are so known to exist—effectiveness is wanting. A leak on thedelivery side of a pump is instantly visible, the water spurting at every stroke.

Leaks affect injectors the same as pumps, and in addition, the accumulation of lime and other mineral deposits in the jets stops the free flowing of the water. The heat of the steam is the usual cause of the deposits, and where this is excessive it would be well to discard the injector and feed with a pump. In many industries it is impracticable to use a feed-water heater and purifier, but when this is not so it will be found a great aid, for one of the most important cares of an engineer is to keep the boiler clean. No scale should be permitted to collect. Mud should be allowed no place in a boiler. The writer has seen the sheets in the water leg of a locomotive type of a boiler sprung half an inch between stay bolts six inches apart, from accumulation of scale lodging and burning fast there.

There are many compounds in the market that are recommended for dissolving scale. They should be used with care. Some are strong enough to "dissolve" the boiler.

Of the many other duties relative to the care of boilers, some further reference will be made in subsequent papers, the aim being to furnish the novice with the necessary information to prevent his too ready acquaintance with the Great Mystery.

EARLY EXPERIENCE OF JACK B.

At one of the re-unions of "Old Timers" held two or three years ago, Jack B. entertained the company with some of his early experience which we think ought to be read by those who were unfortunate enough not to be present, because so many new beginners have a similar experience, and they will be glad to know that there were other unlucky mortals besides themselves. His story was as follows:

My first experience was in a railroad office at a small town in Ohio. The privilege of practicing telegraphy was accorded me in consideration of my acting as "All Around Man" for the agent and operator.

After much humiliation and hard work, I was given a recommendation which stated that I could send twenty words a minute and read fairly well on a register. I wrote an application to the superintendent for employment, reading as follows:

"Will you please give me a berth as I need it very much? Enclosed find recommend."

In due time an answer was received as follows:

"Your application received and filed."

This was a cipher letter to me, but the agent translated it.

Two months later I was ordered to report at "F" office for duty, and when I stepped upon the train with a new crisp pass in my pocket, the happiest moment of my life was experienced.

Arriving at "F," I found the regular operator had absconded and left for parts unknown, but he had kindly left the telegraph instruments, although he might as well have taken them, for all the service they were to me. The register was dead, but the relay kept up an unintelligible rattle. Something had to be done, and I commenced upon the local battery and gave it a thorough cleaning, but still the register failed to show any signs of life. At last I discovered that one of the wires had been removed from the register binding post. A ray of sunlight fell upon my heart, but vanished again when the restored wire failed to produce the desired results. The heavy armature could be seen to quiver a little, but no impression was made upon the tape. In blank despair, I wrote to the superintendent, detailing my troubles, and asked what should be done. Two days later the lineman made his appearance and after a careful inspection decided that the "local" was of no account, and together we went to work upon it.

The porous cells were cleansed and scraped; the zincs were scraped until they looked like new. The coppers were similarly treated and the earthenware jars were filled up with warm rain water. To make success doubly sure, a handful of salt was added to each jar.

When making the connections the lineman remarked that if the battery did not work now, it never would, but the old marble based register stood like a tombstone, and only responded with a quiver.

The lineman left on the next train, and I would have given my last nickel to have gone home also, but the orders were to remain a few days and give the battery time to "get strong."

At the close of the first week I was sitting in my chair with one elbow on the table, my hand supporting my head and dreamily musing upon the miscries of this life, while with my left hand I picked aimlessly at the silk covered wire leading upon the register magnet to the marble base, when suddenly the old machine started up as if a demon had entered into it. I fell backward upon the floor, and my first impulse was to get out of the office, but recovering from the shock and fright, I undertook to discover what had caused the old register to become so active all of a sudden. This was an easy task.

The two wires leading from the magnets to the base had been bent over so as to touch the helix bar and the magnets were out of circuit. Picking at the wire had pulled it away from the bar and the magnets were thrown into circuit.

The office was now open for business, and everything passed off smoothly for two weeks when new troubles appeared. The old telegraph table had been bored full of holes, and the ink and dirt accumulation made it present a very untidy appearance. I conceived the idea of covering the top with oil cloth, as a cheap way to improve its appearance. The office was provided with two wires and two sets of instruments, a switch being arranged to transfer the register from one circuit to the other. One whole night was occupied in removing the instrument, tacking on the oilcloth and replacing the instruments.

Next morning the office presented a much neater appearance, and I was congratulating myself, when "F" was called and asked to open No. 1 a moment, and "say when." The next message sent over the wire was to Jo Hicks, the lineman, and it read thus: "Nos. 1 and 2 'water crossed' between 'F' and 'N' offices," but as there had'nt been a drop of rain within four weeks, Jo concluded the water cross must be in some office. and he took the first train for "F." When he came into the office and saw the new oilcloth covering on the table he swore terribly, and said us kids would soon bankrupt the company if we kept on.

He then took his knife and started in on the oilcloth, and when he finished the largest part of it had disappeared. Two days later I received a letter from the superintendent, stating that oilcloth was a conductor of electricity, and that I might as well have used a sheet iron covering and placed both keys upon it. I was threatened with immediate discharge if there was any more meddling with the wires or instruments at my office in violation of rule "23." Every operator likes to have the instruments and wires arranged according to his particular ideas, and the temptation to meddle with them is very great.

I had no ambition to further improve the appearance of the office for full two months, and then my desire to lower the switchboard so that I could reach it without getting out of my chair was absolutely uncontrollable. The main wires and the instrument wires all passed from the table up the wall to the board, and to lower the board it was only necessary to cut the wires off and make them a little shorter.

Certainly there could be no harm in this, and another night was spent in accomplishing it. Next morning I listened to every word that passed over the line to see if there was anything going to Jo Hicks about trouble on the wires. To my delight the wires both worked clear, and I felt that one job had been successfully accomplished. On my way from dinner I saw some nice new silver extension penholders in a jeweler's window, and resolved to possess one, but it would have been better for me had I purchased a rattle snake. I shall never live long enough to forget the grief it gave me.

The switchboard having been moved down where it could be reached conveniently, furnished a nice pen rack, and when the new silver extension pen was not in use, it was carefully laid up on the four binding posts located at the bottom of the board. Sometimes it would cut one set of instruments out and again the other set.

If it happened to rest on the two center posts it crossed the wires. The following morning I heard a message going to Jo Hicks, telling him to look for a swinging cross between "F" and "N" offices, and a cold chill passed down my spinal column. I examined every inch of the wire about my office and felt sure there was no swinging cross here. Jo came and took a survey of things, but luckily I had the penholder in my hand. He tested the wires and said there was no cross, and he guessed the testing operator at "J" must have had a fit. I expected every minute to hear him say some thing about the switchboard being moved, but he never discovered it and left on the first train going west. As soon as I reported the train I laid the pen on the binding posts, and in less than three minutes I heard another message going to Jo, saying the cross between "F" and "N" was now solid and to not waste so much time in getting it out.

He walked over the line next day but couldn't find the cross.

It happened on this morning that the pen cut out my instruments on the train wire, and I didn't hear a call on it until afternoon, when the pen was removed. The dispatcher told me on No. 2 wire that my office was bewitched, and that Jo Hicks had been ordered to go there and make a careful examination. He came, but when he entered the office I was using the fateful pen in recording the arrival and departure of the train. Jo gave it up and said he couldn't find any cross. The next morning, after No. 7 left, I walked into the office and reported it, and just as I laid the pen upon the binding posts some one entered the office and asked me if I was Jack B., and when I answered yes, he said he was superintendent of telegraph and had come to see what was the matter with the wires, but before finishing his remarks his eyes fell upon the pen and he said rather sharply, "Young man, did you put that pen on the switchboard?" "Yes," said I. "Is that where you usually keep it?' was the next query, to which I replied in the affirmative. He was too mad to explain what the trouble was, but made out to say I was discharged. I went home sad at heart, and loafed around for three months, when to my surprise I received a message requesting me to go to "XY" office. The next train brought a pass and a letter stating that I would be given one more chance, and that if ever I violated rule 23 again, or interfered with the working of the wires, it would result in my final discharge. I resolved never to touch another wire or move another instrument, and I kept the resolution, but my troubles came just the same.

I hadn't been at "XY" quite a month when I heard the pay car was coming over the road. Of course, there was nothing due me, but I went out on the platform to see the train come in. The first person to alight was the superintendent of telegraph. Remembering that I had been oiling my revolver and left it lying on the operating table, I rushed back into the office, grabbed up the revolver and stuck it behind the switchboard, as that was the most available place in such an emergency. The superintendent came in, took a chair and asked me how I was getting along. Before I could reply the testing operator called me and said, "Open No. 2," and "say when."

In another moment he said the wires were crossed between my office and the next one west, and then he rattled off a message at a great rate to Jo Hicks, telling him to go to "XY" and see what was the matter; that wires were crossed again. This, of course, the superintendent heard, and he turned to me and said: "You seem to be particularly unfortunate in crossing the wires at your office." I said, "Yes, but it was certainly not intentional." I wanted to do right but the fates seemed to be against me. He then commenced looking around the switchboard and in another moment pulled out the revolver, saying, "Here is the fellow that caused the cross." The barrel had touched the brass nuts connected with the straps of the two wires. I was advised to enter some other profession; that there was no hope for me as an operator. I had but little to say, but closed up my accounts, made out a monthly report to date, and sent it with the receipts of the office to the superintendent's address. I was too late that day to send by express according to rule, and as I was ready to go home I just sent it by baggage mail and took the train baggage master's receipt for it. On reaching home my appetite was gone; hopes for the future all blasted, and by the following day a high fever had set in and I was delirious. For two months my friends had no hope of my recovery. During my delirious moments they say I was constantly pleading with Jo Hicks, telling him the cross was not in my office.

I finally recovered, but there wasn't money enough on the pay car to induce me to accept another railroad office, and I decided to try my fortunes with a commercial company, and at a large office, where there would be chief operators to watch me and tell me what not to do.

It was not long before I secured the desired position; but as a parting

shot, the railroad telegraph superintendent notified me that the last remittance I made by baggage mail had been lost or stolen, and as I had violated rule "27" by not sending the money by express, I must make it good. The baggage master's receipt was of no service to me. I had violated the rules and must suffer for it.

There was just enough due me for four weeks service to pay the loss, and thus the accounts balanced and my railroad career ended forever. Thirty years have passed since that last fateful day and I am in the telegraphic service yet, but the witch forsook me when I was divorced from the railroad. —*Journal of the Telegraph.*

BALANCING RECIPROCATING PARTS OF A STEAM ENGINE.

The piston, piston rod, crosshead and connecting rod are the reciprocating parts of a direct acting steam engine, largely influencing the action of the steam pressure on the crank pin. While the crank, fly-wheel and other rotating parts have a nearly uniform motion ; these reciprocating par s (excepting the connecting rod) are at complete rest twice during each revolution; and between these two instants of rest there is a period during which they acquire a velocity even greater than that of the crank itself. It follows, from the foregoing, that these reciprocating parts must be accelerated during the first part of the stroke, the acceleration decreasing as the maximum velocity is attained, becoming zero at that point ; and after passing the position of maximum velocity, the parts are retarded, this retardation increasing to the end of the stroke.

The first law of motion is that " Every body continues in a state of rest or uniform motion in a straight line unless compelled by impressed forces to change that state." We learn from this that any increase in the velocity of a mass is accomplished only by the expenditure upon it of energy; but energy exerted in increasing velocity of the mass, purely, may be entirely regained during the retardation of the mass. This process is spoken of as the *storing* and *restoring* of energy. The fly-wheel stores up energy during that part of the stroke in which the effort exerted on the piston is in excess of the resistance, and restores an equal quantity of energy during the period in which the resistance is in excess. The fly wheel is accelerated during the first period, and retarded during the second causing a fluctuation of speed in every stroke; but the mass and diameter of the fly wheel are made great enough to keep this fluctuation within limits.

It will now be evident that during the first portion of the stroke, part of the force of the steam is being used simply to increase the motion of the piston, crosshead, etc., the exact proportion so used, at any instant, depending upon the weight of these parts and their acceleration ; and the energy so stored is given out during the latter part of the stroke.

The mathematical reasoning involved in treating his subject cannot properly be entered into at this time ; but directions for determining and showing the effect of inertia in the reciprocating parts can be given.

It has been already said, that during the first part of the stroke a portion of the pressure of the steam is expended in accelerating the reciprocating parts ; and to find the effort, still available for useful work, this force must be subtracted from the effective steam pressure. In the latter part of the stroke, of course, the pressure on the crank pin due to the reciprocating mass, is to be *added* to that of the steam. We can calculate the accelerating (or retarding) forces at various piston positions, and add (or subtract) them from the corresponding steam pressures.

The work of acceleration can be represented by a diagram; just as the work of the steam in the cylinder is represented by an indicator diagram, by letting horizontal distances represent piston travel and vertical distances represent accelerating forces.

Such a diagram is shown by the shaded area in Fig. 1, which is placed upon an ideal indicator diagram. The length of the vertical line from

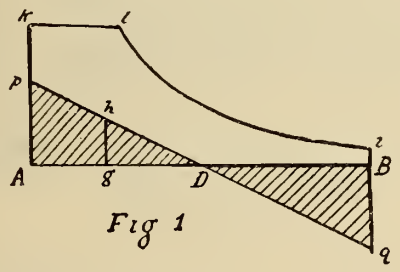


Fig 1

any point, *g*, in the left hand part of the horizontal base line, to the top line of the shaded part, gives the force exerted on the reciprocating parts in accelerating them at the corresponding piston position ; and any similar line measured downward, in the latter part of the stroke, gives the effort exerted by these parts in being retarded.

The acceleration diagram would be bounded by a straight inclined line as *p q* in Fig. 1, if it were not for the angularity of the connecting rod. Neglecting this angularity, for the present, we can then draw the diagram, if we but determine the forces exerted on the reciprocating parts at any two points, as at the beginning and end of the stroke. In the case now under consideration these two forces are equal but opposite, and one would be represented by a vertical line above the base line, the other being of equal length but lying below the base, as *a p* and *b q*, in Fig. 1. These lines should, of course, represent the two forces to the same scale as that employed in the indicator diagram, when the two are to be compared. Having drawn the straight line *p q*, through the points *p* and *q*, the force exerted at any other piston position can be read off by measuring the height of the diagram at that position, exactly as is done in measuring steam pressure on an indicator diagram.

The forces exerted *upon* and *by* the reciprocating parts at the two ends of the stroke, when not considering the action of the connecting rod, are found by the following rule : *Multiply together the weight of the reciprocating parts, the square of the number of revolutions per minute, the radius of the crank (in feet), and the number .00034 ;* the product equals the force required. To reduce this force to equivalent pressure per square inch of piston (which of course must be done to compare it with indicated steam pressure) divide it by the area of the piston in inches. The quantities thus determined are the ones represented in the diagram, Fig. 1, by the lines *p a*, *h g*, *b q*, etc.

It will appear from the foregoing that the piston has its maximum velocity at the middle of the stroke, when the acceleration becomes zero. This is indicated by the acceleration line crossing the base line. But when the angularity of the connecting rod is taken into account, we must treat the case somewhat differently. It is well known that the effect of the ordinary connecting rod is to cause the piston to make the first half stroke, from the head end of the cylinder, in less time than it makes the second half; and the reverse of this occurs in moving from the crank end. Thus in Fig. 2, *A D* is passed over in less time, and consequently at a higher velocity than *D B*. The connecting rod also causes the piston position for maximum velocity to occur nearer to *A*. This position, *E*, is always that at which the crank and connecting rod form a right angle with each other at *C*, and it may be located as follows : draw *G H*, Fig. 2, to represent the stroke (most

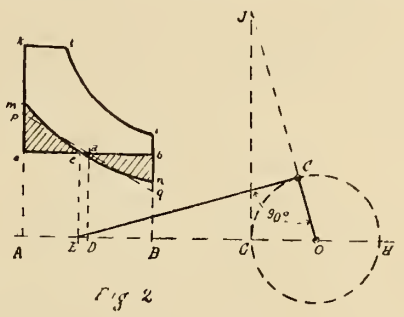


Fig 2

conveniently taken of same length as the indicator card). A circle on this line, with center at *O*, will represent the crank circle. Then draw the vertical line *G J*, of a length equal to that of the connecting rod, to the same scale as the rest of the figure, and connect *J* and *O*. Where *J O* cuts the circle, at *C*, will be the crank position for maximum piston speed. Prolong *G H* to the left, and then with a radius equal to the connecting rod, and a center at *C*, cut this center line at *E* ; this locates the piston position for maximum velocity. With the same radius and centers at *G* and *H*, cut the line of centers in *A* and *B*, thus locating the dead points.

As *E* is the position for maximum piston speed, it must be the point where acceleration ceases and retardation begins : then if the indicator card be shown above *A B*, the crossheads path, by the diagram *a k l i p a*, the point *e*, corresponding to *E*, will be the intersection of the acceleration diagram and the base line, *a b*.

Calculate the forces exerted on and by the reciprocating parts, by the rule already given the lay off *a p*, and *b q* equal to them, respectively. Now as the force is greater than the amount thus calculated for the left hand end, and less for the other end, owing to the velocity of the piston being greater in the first half stroke than in the second, we see that, considering the effect of the connecting rod, *a p* is too small and *b q* too large. The amount, *m p*, (=*n q*), to be added to the former, and to be subtracted from the latter, is found by multiplying *a p* (equal to *b q*) by the length of the crank, and dividing it by the length of the connecting rod.

Having made these corrections, we have three points, in the curve *m*, *e*, *n*, and a circular arc passed through these three points is a close enough approximation to the true acceleration curve for all practical purposes.

It will be seen from this discussion that there are two means of adjusting the action of the reciprocating parts of the variation of steam pressure ; first by changing the weight of these parts ; second, by changing the speed of the engine ; for by the rule given for finding the effort, we multiply by this weight and also by the square of the number of revolutions.

This principle was first developed and put into practice by Mr. Charles T. Porter, on the Porter-Allen engine. Previous to this application the parts were made as light as was consistent with strength.—*Northwestern Mechanic.*

The boiler which is said to be the largest in the world was tested in July, 1890, at one of the electric light stations in New York. It is encased in a vertical shell, which is three-fourths of an inch in thickness. It contains 600 tubes, each of which is three inches in diameter. The length of the tubes, if stretched out in a straight line, would extend to 7,200 feet, or very nearly a mile and a half. The whole boiler contains 6,000 square feet of heating surface, and is of 1,000 horse power. The shell of what is termed the Lancashire boiler is 28 feet long and seven feet in diameter. The barrel of a locomotive boiler is 10 feet long, and a little more than four feet in diameter. The marine boiler has a shell 12½ feet in diameter, and 16½ feet long. The boiler tubes serve to diffuse the heat through the mass of water in locomotive and other boilers.—*Fire and Water.*

ARMATURE BURNOUTS.

It is not always the case that the burning out of armature coils is due to overload. Such accidents are liable to occur from various causes which are avoidable, and it often happens that burnouts which are ascribed to overload are really due to something else.

A prominent case of this character is described on another page in an article by Mr. E. E. Stark, an electrician of this city. Last Fall there was a remarkably large number of burnouts in alternating-current dynamos in this city for a short period. It was during a cold, dry spell, and among the machines under Mr. Stark's charge the trouble occurred with a frequency that was serious and which led to the suspicion that it was not due to overloading at all, but something entirely different. It seems that the true cause of the trouble at this particular time was discovered by an accident. One of the workmen about one of the dynamos received a Leyden jar shock while touching some parts of the machine which at once opened the way to a determination of the cause of the trouble. It seems that the static electricity generated by the rapidly-moving belt accumulated on the iron framework of the machine, and when it attained a sufficient potential it broke down the insulation of the armature-coils, thus burning them out. The remedy for this trouble was found in grounding the base of the dynamo, but as this expedient was inadvisable on account of the possibility of developing other trouble through the use of a ground connection, experiments were made which resulted in a complete solution of the problem without the necessity of maintaining a direct-ground connection.

A small Geissler tube, constructed to discharge at a potential lower than that capable of piercing the insulation of the armature-coils, was connected between the base of the dynamo and the ground, and the battle was won. These Geissler tubes are now doing good service in this direction, and no doubt their general adoption would save a great many armatures.—*Electrical Age.*

THE PACKARD LAMP COMPANY.

The Packard Lamp Company, Ltd., of Montreal, has fitted up a complete and commodious incandescent lamp factory at 96 to 100 King St., and is now manufacturing lamps to supply consumers and the trade in Canada. The lamps manufactured are the latest type of "Packard High Grade," in all respects similar to those made by the New York and Ohio Company at

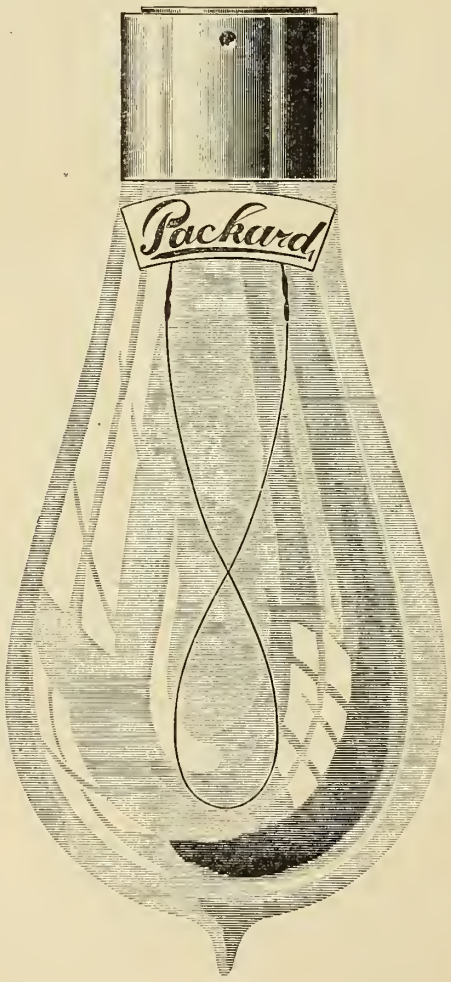


Fig. 1.

Warren, Ohio, the factory being under the personal management of the Messrs. Packard, with Mr. F. E. Cavanaugh as Superintendent.

The Packard lamp has, in the States, attained a reputation second to none, and its brilliant record has been continuous. In a recent disinterested and impartial test of all the various makes of incandescent lamps, the "Packard" is said to have proved to be distinctly ahead of all others in brilliancy and maintenance of candle power.

The new firm, having the only independent lamp factory in the Dominion, making a lamp of an established reputation, and being very advantageously situated as regards the employment of labour and the supply of materials, should be able to command an extensive trade. The complete lamps in all their details, and adapted to any base, voltage and candle-power, are manufactured in the King Street factory, none of the parts, as is sometimes the case, being imported, but all are made from the raw materials on the premises. The equipment of the factory,

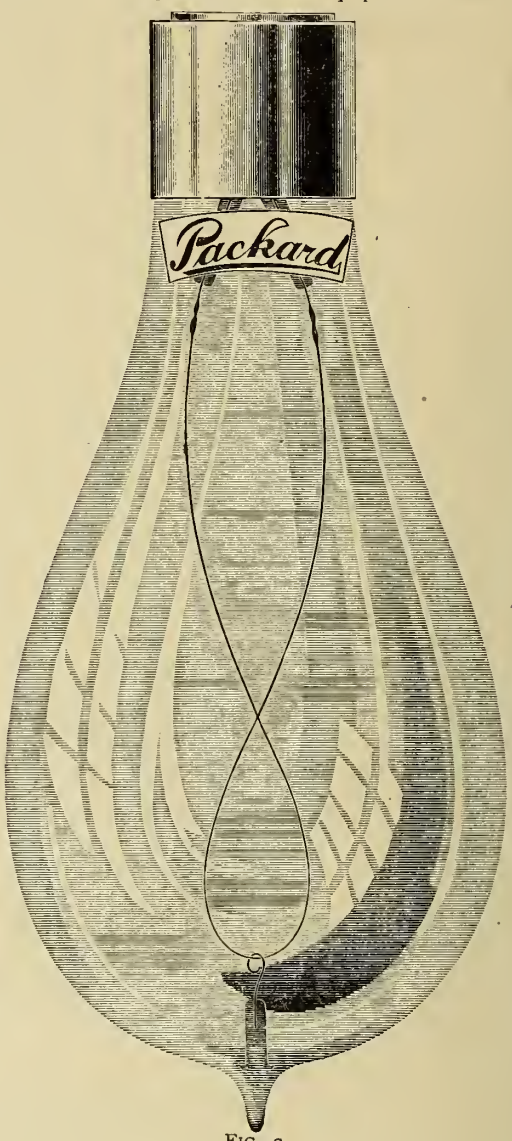


Fig. 2.

in instruments, pumps and all apparatus, is of the most complete and perfected type.

In the accompanying cuts, Fig. 1 represents the regular 16 candle-power low volt lamp, such as is employed on the alternating circuits generally used for commercial lighting.

Fig. 2 shows the special street railway lamp in which the carbon is supported at the top by means of a platinum hook, effectually preventing any damage which might result from the excessive vibration to which lamps so used are subjected.

The company start out with several very large orders booked, and are prepared to increase their output as the demand for their product arises.

PUBLICATIONS.

The third instalment of the argument in behalf of Lord Bacon as the author of the Shakespeare plays, is presented in the September number of the *Arena*. The discussion grows in interest as it proceeds. The September *Arena* also contains brilliant papers by Ibn Ishak, Rev. M. J. Savage, James A. Herne, Hamlin Garland, Congressman John Davis, Prof. Willis Boughton and other representative essayists, together with a powerful symposium on Woman's Dress Reform, prepared under the auspices of the National Council of Women of the United States.

A VIEW OF THE WORLD'S FAIR BUILDINGS,
in the form of a large sized lithograph, in eight colors, with key to same, can be had by sending your address with twenty cents in postage stamps, to Geo. H. Heafford, G. P. A., Chicago, Milwaukee & St. Paul R'y, Chicago, Ill. As the supply is limited, applications must be made early. Should the supply become exhausted the postage stamps will be returned to applicant.

CALCULATING CHIMNEY DRAFT.

To find the draft of a chimney, says the *Northwestern Mechanic*, the best way is to attach a bit of rubber hose terminating in a water-line glass bent into the shape of the letter U. This is filled with water and the hose attached to one end, the other end of the hose being connected to the base of chimney. Twice the difference in level between the water in the legs of the U glass, will be the draft of chimney in inches of water.

Another method of obtaining the result in fractions of a pound, is to subtract weight of cubic foot of air in the chimney, from the weight of the same quantity of air outside, and multiply the product by the height of chimney or stack in feet. The result will be the value of the draft. The following table of the weight of a cubic foot of air at different temperatures will be necessary for obtaining the weight of air from the outside and inside of chimney. The temperature being known by the use of a pyrometer and a thermometer, this may readily be ascertained.

TEMPERATURE AND PRESSURE OF AIR.

Temperature	Weight of one Cubic Ft.	Temperature	Weight of one Cubic Ft.
0	.086331	360	.048476
32	.080728	380	.047323
40	.079439	400	.046223
50	.077884	425	.04492
62	.076094	450	.043686
70	.07494	475	.04252
80	.073565	500	.041414
90	.07223	525	.040364
100	.070942	550	.039365
120	.0685	575	.038415
140	.066221	600	.03751
160	.064088	650	.035822
180	.06309	700	.03428
200	.06021	750	.032865
210	.059313	800	.031561
212	.059135	850	.030358
220	.058442	900	.029242
240	.056774	950	.028206
260	.0553	1000	.027241
280	.05371	1500	.020295
300	.052297	2000	.016172
320	.050959	2500	.013441
340	.049686	3000	.011499

THE MOTOR-MAN.

I would like to sing in a pleasing strain,
Yet, I fear I'll end in a sad refrain ;
For the subtle forces of nature now
Are employing many a thoughtful brow,
In the field of progress, day and night,
To gather them in and hold them tight,
'Till steam shall yield to the lightning plan,
And the engineer to the motor-man.

Let the sceptics scoff on every hand
Let them doubt when they cannot understand ;
But the mighty forces of steam must yield
To a mightier force, now scarce concealed
From the public view, but the gauzy veil
May be soon pulled off, and upon the rail
There will come a change in time's briefest span,
When we all must bow to the motor-man.

When Galileo preached his creed,
But few of his listners did him heed ;
When Watts saw the lift on the kettle's lid,
He knew underneath there were forces hid ;
When Fulton first launched his tiny boat,
Who'd dream of the palaces now afloat ?
And when Morse his wires o'er the house-tops ran.
Who'd think of the coming motor-man.

Alas, alas ! for the engineers,
How their bones will bleach in a few more years
In the boneyards over the country wide,
Where we'll all be thrown, bereft of pride.
We may then sit down, and our cuds can chew,
Telling stories of days when we filled the view
Of the public eye, when we lead the van,
Ere we heard a word of the motor-man.

What a mass of song in our simple way
I have chorused up for many a day !
How I tickled the ribs of the engineers,
And won pleasing smiles from their comely dears.
As I sung the joys of their railway life,
And I pictured pains of our daily strife,
As we forward marched in the labor van,
But I cannot sing for the motor-man.

I am now too old to begin anew,
I shall end my days with the engine's crew ;
For the dynamos and the Leyden jars
I no more could catch than the distant stars.
In the cabs we reigned with a swing supreme
In the glorious days of the age of steam ;
We must march in a ghostly caravan
When we're crowded out by the motor-man.

—*Locomotive Engineering Journal.*

THE "CLARK" WIRE.



Insulation Guaranteed wherever used, Aerial, Underground or Submarine.

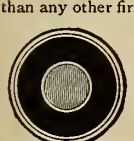


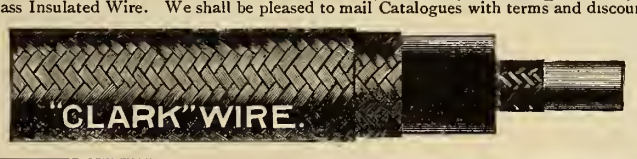
In a letter from the Inspector of the Boston Fire Underwriters' Union, he states : "A thoroughly reliable and desirable Wire in every respect."

The rubber used in insulating our wires and cables is especially chemically prepared, and is guaranteed to be water-proof, and will not deteriorate, oxidize or crack, and will remain flexible in extreme cold weather and is not affected by heat. The insulation is protected from mechanical injury by one or more braids, and the whole slicked with Clark's Patent Compound, and special extra finish, which we have now adopted for all our solid wires as an extra weatherproof protection, and also preventing chafing and abrasion, which is water, acid, and to a very great extent fireproof. Our insulation will prove durable when all others fail. We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph and Electric Lights from stock. Cables made to order. We are now prepared to furnish our Clark Wire with a white finish for ceiling cleat work as well as our standard color.

Clark Joint Gum should be used for making waterproof joints. This is put up in half-pound boxes, in strips about one foot long and five-eighths inch wide, and when wrapped about a joint and pressed firmly it makes a solid mass. **For railway and Motor** use, we make all sizes of stranded and flexible with Clark insulation.

We guarantee our Insulation wherever used, Aerial, Underground, or Submarine, and our net prices are as low, if not lower, than any other first-class Insulated Wire. We shall be pleased to mail Catalogues with terms and discounts for quantities.





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FOR LIGHTING AND TRANSMISSION OF POWER.

Constant Current and Constant Potential Dynamos, for Arc and Incandescent Lighting.

Electric Railway Generators and Motors.

Stationary Motors of any horse-power, to run on Arc and Incandescent Circuits.

Arc Lamps for Constant Current and Constant Potential Circuits.

Our Dynamos, Generators and Motors are automatic and self-regulating.

All kinds of Station Fixtures, Switches, Lightning Arresters, Rheostats, Ammeters, Volt-meters, &c., &c.

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SPARKS.

Authority is being sought to operate an electric street railway at Belleville, Ont.

The Dominion Telegraph Co. have just paid a quarterly dividend of 1½ per cent.

A Belleville firm is said to have commenced the manufacture of electric street cars.

The Bell Telephone Co. and Montreal Telegraph Co. have each granted a quarterly dividend of two per cent.

Mr. Granville C. Cunningham, late City Engineer of Toronto, has been appointed electrical engineer of the Montreal City Passenger Railway Co.

Hang a wet towel in front of your electric fan and you will find that your room or office will be much cooler. Moist air is better than dry air for cooling purposes.—*New York Electrical Review.*

Mr. J. J. Wright and the members of his family, accompanied by Mr. A. B. Smith and family, recently spent a very pleasant week on board the yacht "Electric," cruising on Lake Ontario between Toronto and Kingston.

The importance of using good varnish in electrical apparatus cannot be over-estimated, says the New York *Electrical Review.* A good method of testing is to cover a sheet of paper with several coats of varnish, and attempt to pass a 3,000 volts alternating discharge through it. If the varnished paper resists the discharge, it is suitable for electrical use.

In an electric arc the positive pole is hotter than the negative, the positive showing a temperature of about 4,000 degrees C., the negative showing a temperature of 3,000 degrees to 3,500 degrees C. This difference of temperature produces a counter electromotive force which acts like ohmic resistance. The cause of the positive pole wearing away twice as fast as the negative is due to this difference in temperature.—*Scientific American.*

SITUATION WANTED

By practical Electrician; over 9 years' experience as generator or motor builder, repairs, etc. Charge of central station, or inspecting, running and laying out plants. Highest references; open for engagement 19th September.

"PRACTICAL,"
CANADIAN ELECTRICAL NEWS, Toronto.

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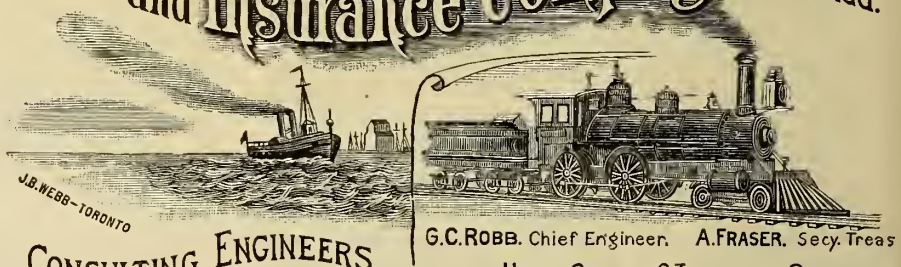
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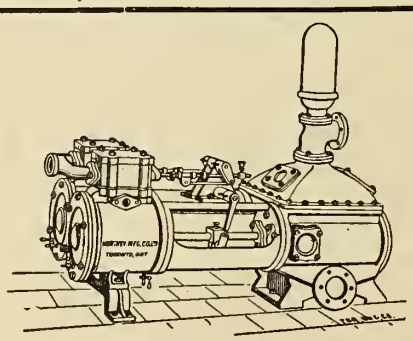
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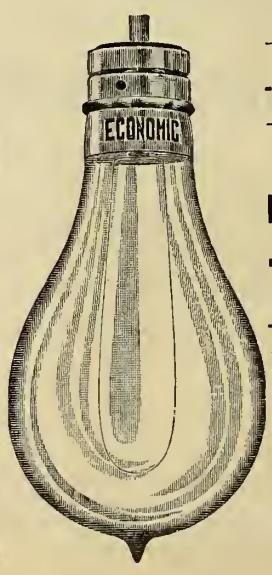
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CANADIAN AGENT FOR

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251 ST. JAMES STREET,
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SPARKS.

The contract for cars for the new electric street railway at Brantford has been given to Patterson & Corbin, St. Catharines.

The incorporation at Montreal of the Packard Lamp Co., with a capital of of $6,000, is announced. The company will manufacture electric lamps and machinery.

The Light, Heat and Power Company, Newmarket, Ont., has been incorporated with a capital stock of $40,000 to make and supply electric, steam and water power.

The limited Sunday car service which obtained in Hamilton under the old *regime*, will it is said be discontinued, for the reason that it would not pay the company to get up steam for the purpose.

The Canadian General Electric Company, with headquarters at Montreal, has been incorporated with a capital stock of $1,000,000 to manufacture machinery, apparatus and supplies of every kind connected with the use of electricity.

The electric railway between Mimico and Parkdale is being pushed rapidly. The iron bridge across the Humber is nearly completed, and the tracks and wires are up as far as the Mimico Creek. It will be ready for running before long.

Mr. L. M. Pinolet, of Montreal, visited Toronto on the occasion of the Edison Convention in the interest of the *Electrical Engineer*, of New York. The other representatives of the foreign press were Mr. Sullivan of the *Street Railway Gazette*, Chicago, and Mr. Price of the New York *Electrical Review*.

The Beacon Electrical Co., have in view the establishing of a factory in Canada for the manufacture of incandescent electric lamps, which is expected to give employment to thirty or forty hands. Mr. H. S. Kaliske, business manager of the company was in Canada recently prospecting for a suitable location.

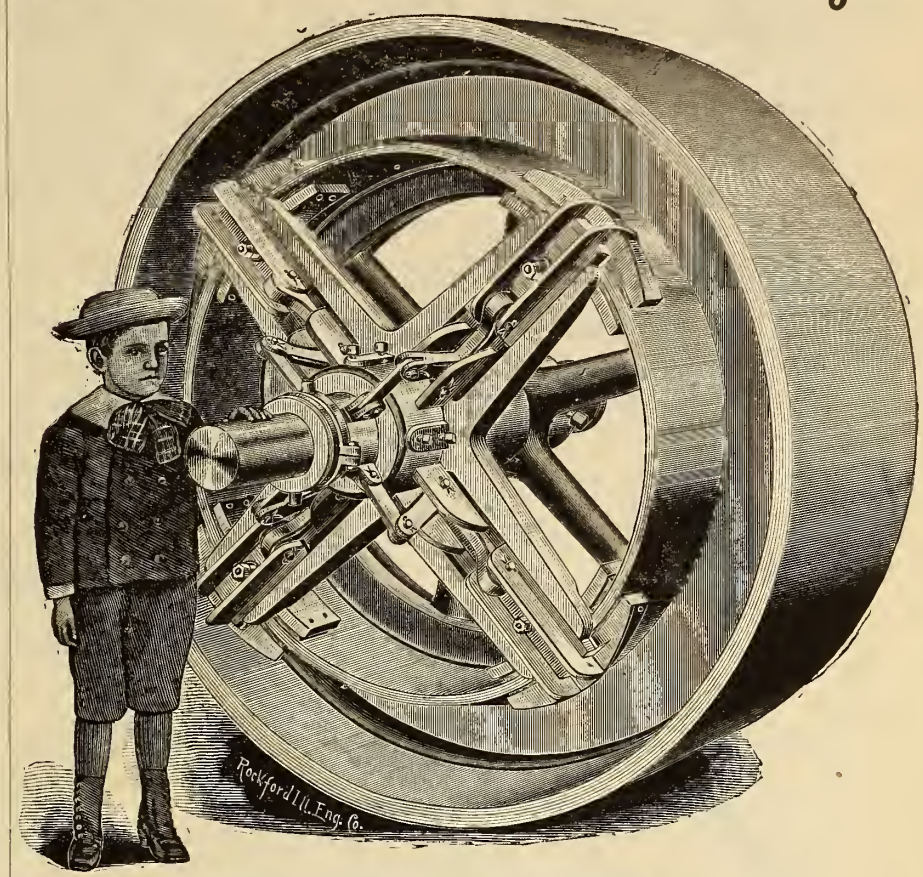
The building known as Pierce's saw mill at the Chaudiere bridge, Ottawa, has been fitted up as the power house of the Ottawa Street Railway, and is about to go into operation, The upper flat is to be used for the storage of wire, on the main floor are the dynamos. Three water wheels, each 500 h.p., one at the front and two at the rear of the building, will supply the motive power. It is the intention of the company to supply heat as well as light and power. The power house itself will be heated by the apparatus devised by Mr. Ahearn.

The following companies are announced as incorporated: The Citizens' Telephone and Electric Company, Rat Portage, capital $40,000; the Manitoulin & North Shore Telephone and Telegraph Company, capital $20,000.

Messrs. C. F. Stacey & Co., of Bathurst, N. B., have recently installed an electric plant, consisting of one of the Consolidated Electric Company's dynamos, two 1,200-c. p. arc lights, ten 24-c. p. and twenty-four 16-c. p. incandescent lights.

A delegation recently waited on the govenment at Ottawa, and asked that the rails used in electric railways which weighed over 30 pounds be admitted free of duty under the same classification as rails used for locomotives. The government in reply stated that electric railways are classified as tramways, and the rails used for electric railways are dutiable, irrespective of weight.

Hill Patent Friction Pulleys



AND CUT OFF COUPLINGS

For Electric Light Stations and all purposes where intermittent power is required.

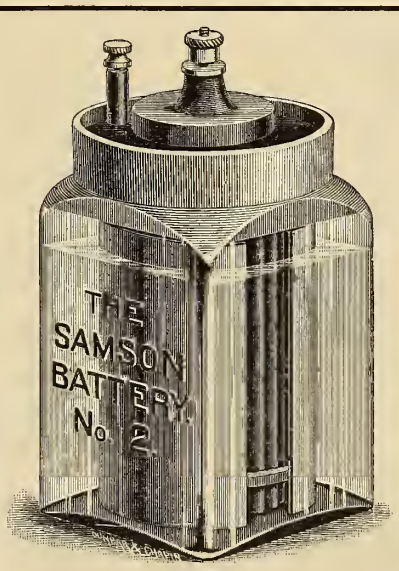
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If you have any pipes or boilers uncovered, you are losing on same at the rate of 80 cents every year on each square foot of surface exposed. By having them covered with our

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you will save 85% of this loss. The saving thus effected in fuel will in one year more than pay the cost of covering, which we guarantee to last as long as the pipes. Our covering is the best fuel saver on the market.

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Equip your Electric Plants, Factories and Mills with

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FAMOUS GRIP PULLEYS

INSTANTANEOUS IN ACTION.

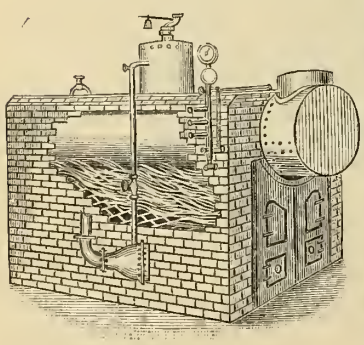
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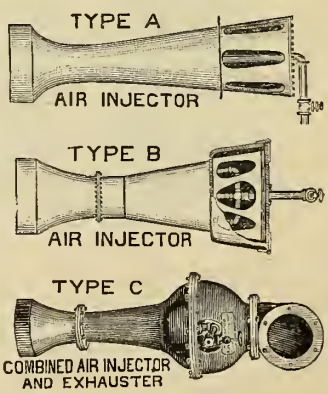
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SAVES TIME, BELTING, POWER.

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Earle's Air and Steam Injectors





THE BEST DEVICE IN THE MARKET

For burning hard or soft coal screenings under steam boilers, for working gas producers, &c., &c., exhausting gases from mines, ventilating ships, buildings, &c. Can be applied to any boiler without disturbing the present setting. Guaranteed to do the work satisfactorily. Can give the best of testimonials showing their efficiency.

THE CANADIAN OILED CLOTHING CO., (L'TD).
Manufacturers of
WATERPROOF HORSE AND WAGGON COVERS, OILED CLOTHING, ETC.

S. R. EARLE, ESQ., Belleville, Ont. PORT HOPE, June 23rd, 1892.

DEAR SIR,—We have had in use for some time, your Combined "Air Injector and Exhauster" and with pleasure we state that it is giving us the most complete satisfaction. Regarding the saving in fuel, we were burning, before using the "Injector," two tons soft coal per week, at a cost of $9.00; after we put the Injector in, we burn two ton hard coal screenings per week at a cost of $2.00 making a saving of $7.00 per week, which speaks for itself. We have a much cleaner and better fire and far less trouble in keeping steam. We consider your invention a boon to all parties using steam boilers. Wishing you every success, we are, Yours truly, (Signed) THE CANADIAN OILED CLOTHING CO.
per S. Henderson, Manager.

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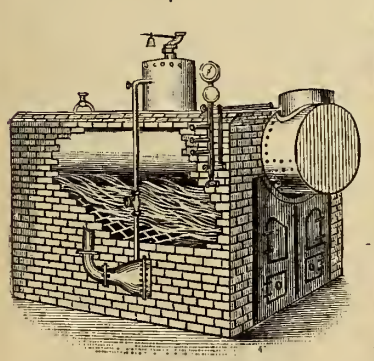
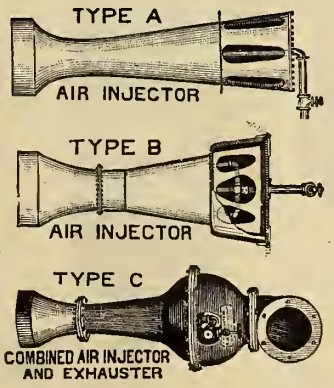
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[This belt has been in constant use since August, 1885, and looks good for another ten years yet.] Also
One 36 inch belt 100 feet long. One 38 inch belt 100 feet long.
One 36 inch belt 123 feet long. One 24 inch belt 100 feet long.
And over 1500 feet of 8 inch belting.
All the above belts are DOUBLE THICKNESS and are all giving satisfaction.
The 38 inch belt is the largest belt ever made in this Province.
The following Electric Companies are also using our Belting :
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The Berlin Electric and Gas Co.
The Woodstock Electric Light Co.
The Manitoba Electric and Gas Light Co., Winnipeg.
The Goderich Electric Light Co.
The Markham Electric Light Co.
The Oshawa Electric Light Co.
The Orangeville Electric Light Co.
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per S. Henderson, Manager.

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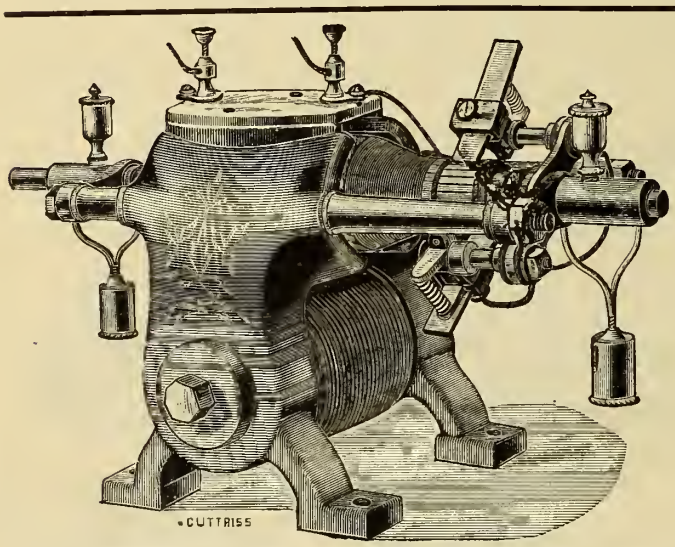
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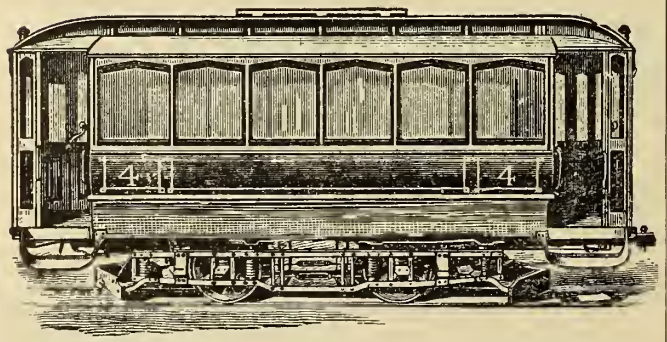
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....OUR SPECIALTY....

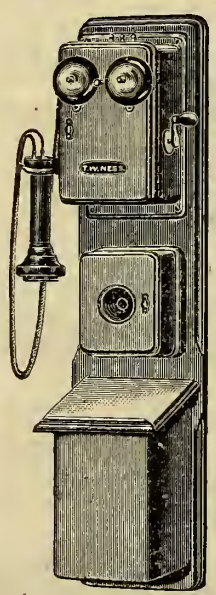


We also manufacture Horse and Trail Cars of every description.

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We manufacture Telephones for *Main Lines, Local Exchanges, and Warehouses.*

Send for catalogue, price list and testimonials.

A SAMPLE LETTER:

BRESLAU, ONT., May 10th, 1892.

T. W. NESS, ESQ., Montreal.

DEAR SIR,—I am pleased to say that the Telephone Instruments we bought from you are giving entire satisfaction. We have now twenty-nine of your instruments on our line, and they appear to work as satisfactory as the Standard Bell.

Yours truly,

ABR. S. CLEMNER.

Write us when you want anything electrical.

Key Sockets,	*Magneto Bells,*
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Canadian Headquarters for Electrical Supplies.

749 Craig Street, MONTREAL.

CANADIAN
ELECTRICAL NEWS
AND
STEAM ENGINEERING JOURNAL.

VOL. II. TORONTO AND MONTREAL, CANADA, OCTOBER, 1892. NO. 10.

BOILER EXPLOSION AT STAPLES, ONT.

On Saturday, the 17th of September, a serious boiler explosion occurred in the village of Staples, County of Essex, Ontario. Staples is a village of recent origin, and is a station on the branch line of railway from Comber to Leamington. The village contains four saw mills and dwellings of the workers. It is surrounded by hard-wood bush, and the chief employment at the mills is cutting and bending the wood and the making of staves for barrels.

Messrs. Force & Dickson had two steam boilers in their stave mill. They were horizontal tubular boilers, encased in brick-work. On Saturday morning a few of the men had reached the mill before starting time, and as it was chilly, were near the boilers to warm themselves.

The engineer was preparing to start one of the engines, and was in the act of turning the fly wheel to bring the engine in proper position for starting, when one of the steam boilers exploded.

The explosion was a very violent one, causing the death of seven men and the complete destruction of the mill. The accompanying illustration gives some idea of the destruction caused by it.

The exploded boiler was torn into a number of pieces and scattered about the mill yard and into the bush beyond. The other boiler was driven out of its brick setting and broken in several places.

A coroner's inquest was held, and the jury found that the death of the man whose body formed the subject of enquiry was caused by the boiler explosion, and that the explosion was accidental and from a cause not known to the jury. Various theories were suggested, such as that the tubes were rotten, and that scale inside caused the bottom to become red hot, but the jury very wisely did not endorse any of these opinions.

An examination of the remains of the exploded boiler showed that several portions had gone completely out of sight, nobody knew where.

The boiler was an ordinary tubular boiler, built in Detroit about nine years ago, and made of charcoal hammered iron plate fully one quarter of an inch thick. It had been twelve feet long and four feet in diameter, and had a dome about 20 in. diameter.



SCENE OF BOILER EXPLOSION AT STAPLES, ONT.

The dome had parted from the shell, tearing the plate near to the dome flange. The part of the shell immediately under the dome was flattened out and lay only a few feet from the original position of the boiler. The upper part of the front of the shell had taken a flight upwards, and lay not far from the dome. The other portions of the shell plates were missing.

The explanation of the cause of the explosion does not seem very difficult. The dome having gone up, and the shell plates under it being flattened out and left near the original site, suggest that the rupture commenced around the dome. The appearance of the fractured plate still rivetted to the dome agrees with this idea, as one part seems wasted and reduced in thickness to about one-half that of the rest of the plate. The manhole plate was not among the remains, and if it were found might give a better explanation than the one suggested.

The boiler had been covered over with brickwork, and a leak at the dome flange could not have been seen and was probably the cause of the corrosion now visible.

The boiler had not been inspected by anyone competent to do

such work since it was erected in Staples. The number of killed in this case, and the distressing condition of some of the families left, are strong arguments in favour of some plan being devised for the prevention of boiler explosions.

The jury, in their verdict, said: "We would earnestly recommend that users of steam should be compelled by law to have their boilers thoroughly tested at least once a year, and that some law enforcing a system of examination for engineers of stationary engines should be enacted and certificates granted to those passing such examinations, proving themselves competent to take charge of engines, and that a penalty be imposed upon any person assuming the charge of an engine who had not a certificate."

THE ACTION OF THE FLY WHEEL.

A fly wheel acts solely by its inertia. While the engine is up to its speed, the fly wheel is absorbing power. Any sudden and momentary tendency of the engine to increase its speed is counteracted in great measure by the fly wheel, which if heavy enough and of sufficient diameter, absorbs nearly all the excess, paying it out gradually until its normal speed is again reached; thus making of what might otherwise be a running away or racing, only a slight gradual increase of speed, followed by a gradual decrease to the normal amount, if the conditions remain normal. In the same way any sudden and momentary tendency of the engine to slow up would be met by the fly wheel by a giving out of momentum; so that what might be a very considerable momentary slowing up, is changed to a very slight and gradual decrease of speed, followed (if the conditions are restored to their normal state) by gradual return to the normal speed. In other words the fly wheel acts as a store house of power. Its inertia causes it to oppose any tendency either to slowing up or speeding up. The greater the weight of fly wheel rim for a given diameter and rotation speed, the heavier the rim for a given diameter and rotation speed, and the faster the rotation speed for a given rim weight and diameter, the more efficient it is in keeping the rotation speed uniform; so that where there are expected great variations of pressure or of load, or where great regularity is intended, it is only necessary to sufficiently increase either the rim weight, the diameter, or the rotation speed.

It must be remembered that a fly wheel can take off only momentary variations in pressure or in load. It only distributes through many rotations an excess of power that would be inconvenient if used up during a few; or stores up in retaining the regular rotation speed, enough power to keep the engine going for a few turns at nearly the regular speed, in case of momentary increase of load or decrease of pressure or of load. If the load were taken off and the pressure kept up, or the load kept the same and the pressure doubled, the engine would run away and probably wreck itself, despite the fly wheel; and *vice versa*, if the load were doubled and pressure not increased, or if the load remained the same and the pressure fell to one half, the engine would slow down, fly wheel or no fly wheel.

SOME OF THE TROUBLES OF MANUFACTURERS OF INCANDESCENT LAMPS.

We suppose it will be conceded that every trade has its troubles and every manufacture its difficulties, and that these conditions govern to no small extent the selling price of the commodities; those who vehemently complain of the price they have to pay for their incandescent lamps will do well to bear in mind this platitude. There is scarcely any manufacture that could be instanced in which there is more loss from what may be termed "spontaneous" breakage. Finished lamps apparently well made and of the best material will for no very obvious reason crack without having been subjected to any shock or blow. Manufacturers of incandescent lamps always expect a reasonable amount of loss from breakage, but when a certain limit is exceeded some special cause is generally suspected to be operating, such as carelessness in the glass-blowing department, imperfect annealing, &c. Lamp-bulbs may exhibit this spontaneous cracking as a rule in three *loci*:—1. Where the platinum wires are sealed in. 2. Where the "stem" carrying the wires and carbon filaments is joined to the bulb proper. 3. Where the exhausting tube is sealed on at the apex of the bulb. Now in addition to the internal stresses existing in any such class of work, the lamp bulb when finished is subjected externally to the full atmospheric pressure, and in, perhaps, the majority of lamps in use, the bulb is subjected to sudden heat stresses due to the instantaneous turning on of the current. This combination of stresses being considered, it is evident that differences in the glass used for the bulb and "stem," and consequent differences in the values of the coefficients of expansion will become of special importance; although in the case of ordinary glass-work subjected to no particular stress, such differences would be negligible. Glass blowers know by experience that similar grades of glass should be used together, but they are skilful enough to be able to work up grades of glass differing in composition far more than is permissible in incandescent lamps. Dr. Durand Woodman has had his attention called to this matter by an American firm of incandescent lamp makers, and he was able to investigate the character of the glass at a time when a percentage of spontaneous breaking was abnormally high, whilst every care in making up the lamps, in annealing, &c., was unavailing. A number of samples of glass rod and tubes used in making the bulbs were examined chemically. From the results Dr. Woodman concluded that the high spontaneous mortality was caused by using different grades of glass in making the lamps. The lesson to be derived from this investigation is obviously that it is desirable to use the same glass in every part of a lamp, or at least glass of practically the same composition. It has been asserted that some glasses of different composition may have similar coefficients of expansion, owing to the constituents compensating each other's effect, but the determination of this characteristic involves problems connected with the coefficiency of expansion, which after all are unnecessary trouble, since it is a simple matter to obtain glass of practically the same composition for all parts of a lamp, or for any other complex glass-work.—London *Electrical Review.*

PLAYING CHESS BY TELEPHONE.

Last December two chess clubs, one in London and the other in Liverpool, played a match game of chess by telephone. The distance between the two cities is about 200 miles. The telephone company arranged to have the receivers and transmitters connected with a direct wire between the two clubs, and stationed in the club room at each end. The success was perfect. As each move was made on the chess board it was at once telephoned to the other club, and the two games proceeded without any hitch or interruption. Several hours were consumed in the games, and when they were concluded every one was congratulated on the success of the experiment. Chess playing is a recreation which is peculiarly adapted to electricians, and many of them are good players and members of chess clubs. One reason why there have been so few team matches between different clubs has been the difficulty of gathering a team which could spare the time and expense involved in inviting another city to play the match. But the telephone affords a ready means by which games and matches can be played at a compararively small expense, and without the members of either club leaving their own comfortable rooms. The success of the London-Liverpool experiment opens the way to many such experiments here, and there is no reason why the clubs in the cities should not play telephonic matches not only with each other but with clubs in adjacent cities.

AN ADVERTISER WHO TALKS BY THE BOOK.

On Friday, an advertiser who has sent us a good many checks, says the *Northwestern Lumberman*, comfortably filled up a good arm chair, and talked considerably about advertising. "When I buy advertising," he said, "I want to feel assured that the paper in which I have space goes to the men whom I desire to reach, and, further, that the people to whom it goes have a good opinion of it. I place my advertising on that basis. I used to think that I did not receive my money's worth unless I could trace a certain number of sales to some particular ad. I am over that. I meet the demand of machinery in my line, and having done that I want to be known, and known all the time. I advertise, say in a dozen papers, and a man comes along and buys a big bill of goods. Can he tell me what particular paper directed him to my work? No; not once in a hundred times. I have been advertising for years so he may know where I am, and when he wants to buy he comes to me. Make first-class machinery, and let everybody know where the machinery can be had, and then treat your customers white, is the way to get business."

ELECTRIC HEATING.

SOME interesting and successful experiments in the line of heating by electricity have been in progress at Ottawa, Ont., for nearly a year past. The apparatus employed is the invention of Mr. Ahearn, general manager of the Ottawa Electric Street Railway. We reproduce from the *Western Electrician*, the following particulars and illustrations of the apparatus :

A cross-section of the electric boiler for car heating is shown in detail in Fig. 1. It consists of a shell or tube *2* of oval cross-section, within which is placed another similar but smaller shell

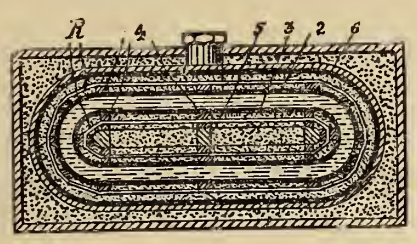


FIG. 1.

3, the two having their ends suitably joined to form a water space between them, nozzles being provided for the circulating pipes. The vessel thus formed has its exterior surfaces insulated with strips of asbestos *4*. A core, *5*, also insulated with strips of asbestos, and wound with a resistance coil *R* of German silver inserted in the inner vacant space of the shell *3*, and is of such a size as to press the wires *R* against the insulation of the shell *3*. A similar resistance coil *R* is also wound upon the insulated shell *2*, the terminals of the coils projecting. The vessel thus formed is placed in a casing *6*, the terminals of the coils passing through insulators, and all the vacant spaces inside the casing being filled with powdered whiting. This casing is then wrapped in sheets of asbestos and inclosed in a wooden box secured to the under side of the car floor. Two of the boilers are used in each car, being placed in diagonally opposite corners, each supplying a set of circulating pipes. The resistance coils are placed within the car circuit. The nozzle in the upper side of the boiler

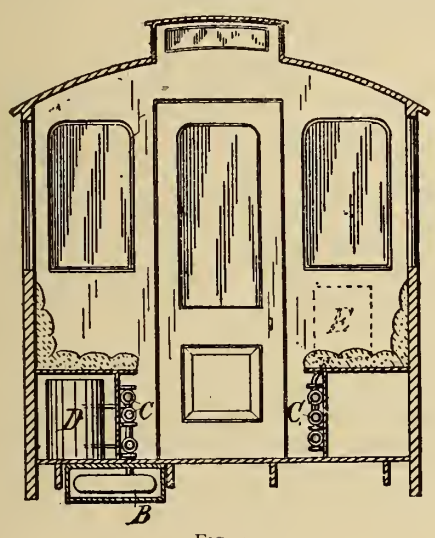


FIG. 2.

is connected with an upright supply pipe ; from this the radiating pipes *C* branch off, running to the other end of the car, where they are connected with another upright pipe. From this last mentioned upright pipe a return pipe passes through the floor and enters the boiler by the lower nozzle. A water reservoir *D* is placed under the seat and communicates with the flow and return pipes to keep the circulating pipes full of water and to compensate for evaporation. An expansion tank *E* is placed at the end, away from the boiler, one in each set of pipes. This tank being high and flat, is concealed in the end panel of the car, and it provides for the variations in the level of the car and the water.

The liquid heater shown in Fig. 3 was next devised. This heater is of handsome design, with a water glass on its side showing the height of the water within it. This type is wound for all voltages, and has, it is stated, been used for the last three months with most satisfactory results by patrons of the Chaudiere Electric Light Company of Ottawa, which company uses the Westinghouse alternating system. These heaters are used by barbers, druggists and for domestic purposes. A livery stable keeper uses a three gallon heater, the hot water being applied to clean harness and bathe horses' feet. The heater shown in Fig. 3 requires 3½ amperes at 50 volts. Such is its construction that when in use in barber shops the water in it is



FIG. 3.



FIG. 4.

found sufficiently hot for shaving in the morning, although the current has been off all night.

In March last Mr. Ahearn had constructed and put in operation in the residence of ex-Alderman Johnstone the electric furnace shown in Fig. 5. This outfit has been in successful and and continuous operation since being installed, and has attracted much attention. The large coal furnace abandoned for the small perpendicular electric furnace shown in Fig. 5 suggests immense possibilities for electric heating. The heated water passes upward into the 63 gallon tank in the corner, from which it flows to the two upper stories of Mr. Johnstone's residence, supplying three bathrooms and one kitchen sink. The fact that hot water is being constantly drawn off, and cold water taking its place, is a much more severe test upon the furnace than if the water was being used for heating purposes only, as in the latter case the water is being circulated always. Mr. Ahearn

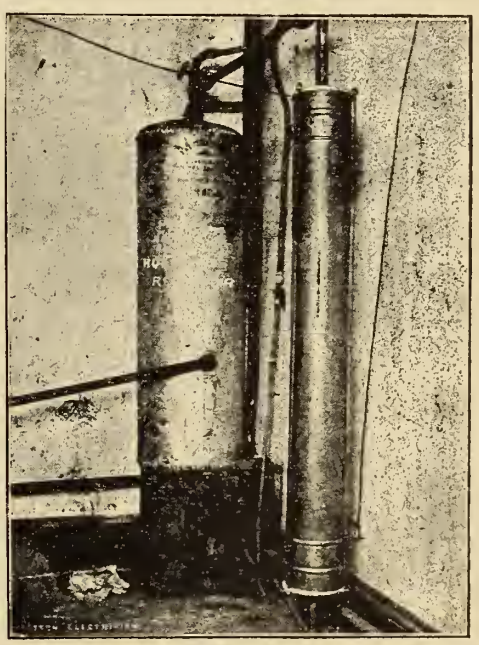


FIG. 5.

has applied this principle to the hot water apparatus employed for car heating.

Mr. Ahearn, proposes this year to equip all the cars, the car shops and the new power house, with his new system of electric hot water heating. He has also arranged with C. F. Sise, president of the Bell Telephone company of Canada, to heat the new telephone building now being erected in Ottawa. This installation alone will require 6,000 feet of pipe. For this undertaking the 50 volt alternating current will be used.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

THE third annual Convention of the above Association was held in Maccabees Hall, Hamilton, Ont., on August 30th and 31st.

The President, Mr. A. M. Wickens, being unavoidably absent, the Convention was formally opened by the Vice-President, Mr. Mackie.

The minutes of the last Convention were read and adopted.

Moved by Bro. Hunt, seconded by Bro. Blackgrove, that Bro. Edkins read the

PRESIDENT'S ADDRESS.

"In opening this, our third convention, my first duty will be to congratulate you upon your fortunate selection of the ambitious city as your place of meeting, and to express myself as exceeding, ly pleased to see so many of our oldest and best tried members here as representatives. I also wish to thank the officers of the Executive Council and the officers of the different Associations for the very cordial support they have given us during our term of office, now extending over two years. Our Associations are steadily increasing in membership, in usefulness and influence. The older Associations are receiving a support from the manufacturer and the steam user, proving conclusively that we are working in the right direction, that our principles are such that no man, whether employee or employer, can afford to ignore us, that we are founded on a rock, the name of which is "Education," and that if we are true to the constitution, true to the promises we made when joining the order, we must become a grand influencial and useful body, looked up to and respected by all classes of citizens. Our Associations are spreading to the east, to the west, to the north, and I can confidently say the time is not far distant when we will extent from the Atlantic to the Pacific an unbroken chain of careful, enerjetic and brainey men who will not be left behind, no matter how fast the Inventor and Engine builder may improve and change the steam plants that may be placed uhder our charge. We are proud of the fact that the members generally are developing a strong fraternal and brotherly feeling, and are in reality helping each other over the hard sports in our journey through life. Brothers, always remember that a complete rope is stronger than a single strand. While our increase during the year has not been as rapid as it might have been, we are pleased to report the opening of one new association in Montreal (D. D. Bro. Thos. Ryan) and the members of montreal No. 1. Have done well in assisting to organize the French Engineers of that city, who were granted a charter as "St. Laurent No. 2, of Montreal," and the privellege of working in their own language was also granted by the officers of the executive. It is to be hoped that the good work will not end at the one French Association, but that we may yet report several.

Unity Association, No. 5, of London, which had lapsed, has been mainly through the efforts of Bro. Edkins, reinstituted, and is now in a fair way to show good work and eventually be of great assistance to the engineers of that city. I am sure all the delegates present will join me in wishing both new Association *God speed.*

The legislation to come before us at this session, while it is not great in amount, is of the utmost importance, and will include a few changes in the constitutions of the C. A. S. E., the consideration of some kind of an accident and life insurance scheme, the adoption of a pin, button, or badge, and the organization of some plan to assist the Association to a regular system of educating their members.

I hope the delegates will earnestly examine everything which comes up and let us sift out, and adopt such measures as will strengthen our order and bind us more securely together.

Our Recording Secretary will give you an account of the membership and finances of the order in as far as he can, I would ask the delegates to impress upon the minds of their Association Secretary the necessity of forwarding these reports to the Secretary of the executive, say during the month of July, so that he may have time to make out a correct report before the convention meets. Let us all do our whole duty and make this coming year a red letter year in the history of the C. A. S. E.

I again thank you for your cordial support of the executive officers and hope you will continue it in a greater and if possible stronger sence to our successors in office.

The Secretary presented his annual report as follows :

SECRETARY'S REPORT.

In making out my annual report for the past year, I regret that I cannot present to you a full report of the financial and numercial standing of the Order. For some reason the Secretaries of some of the Associations have not sent in their half yearly reports with the per capita tax, as provided for in the constitution of this Executive. It would be well in future if the different Secretaries of the Association would attend to this matter of detail, as without such reports, it is impossible for the Executive Secretary to get out a proper statement to present at the yearly meeting for the information of the delegates. I would also remind the brethren that no Association is entitled to receive the password for a new term until the said half-yearly report has been sent in. The only Associations from which I have received a proper half-yearly report are : Brantford, No. 4, and Montreal, No. 2.

	Members on Roll.	Expelled.	Cash Received	Expenses.	Cash in Bank.
Brantford, No. 4.	13	N. P. D. 2	$31.95	$43.45	$20.15
Hamilton, No. 2.	37				
Montreal, No. 1.	74	3	$234.35	$211.03	$126.92
Montreal, No. 2.	88	2	$260.25	$119.31	$60.94
Toronto, No. 1..	68		$246.85	$338.78	$172.15
London, No 5...	19				
Brandon, No. 1..		No Report.			
	299	7	$773.40	$792.57	$380.16

Moved by Bro. Hunt, seconded by Bro. Ogle, that the President's address be received and placed on file. Carried.

Moved by Bro. Hunt, seconded by Bro. Sweet, that a vote of thanks be tendered to Bro. Wickens for his valuable work during the past year. Carried.

Moved by Bro. Hunt, seconded by Bro. Mooring, that Bro. G. Robertson, of Montreal, assist Bro. Edkins as Secretary of this Executive. Carried.

Moved and seconded that the Convention adjourn till 7:30 p.m. to-night when the meeting be open to all Engineers and the public. Carried.

EVENING SESSION.

The Convention opened at 7:30 p. m., with President A. M. Wickens in the chair.

A paper was read by Bro. A. E. Edkins, on "the Care of Steam Boilers," at the conclusion of which a long discussion took place, and was most interesting.

Bro. Wickens then gave a very interesting address on "The Stationary Engineer, and what Constitutes an Engineer."

After considerable discussion on Bro. Wickens' paper, it was moved and seconded, that a vote of thanks be tendered to President Wickens and Secretary Edkins for their valuable papers. Carried.

Bros. Wickens and Edkins replied in suitable terms.

Ald. McAndrew, who was present, was then called on for a few remarks, and in response made a eagolistic speech. He spoke very highly of Hamilton No. 2, and its members. and the order generally as he had observed it.

SECOND DAY.

The Convention resumed at 10 a. m., President A. M. Wickens presiding.

The Committees on "Constitution" and "Good of the Order" reported progress.

The Finance Committee reported as follows :

Your Committee have examined the books and vouchers and found the receipts and expenditures for the current year to be as follows:

Receipts	$77.05
Disbursement	$12.50
	$64 65
Outstanding dues	$11.85

Your Committee recommend that an order book be procured and all demands on the treasurer be signed by the President and Secretary.

Your Committee would also recommend that the mileage rates be paid the various Delegates and members of the Executive Council as follow :

Executive Council	(3)	$7.20
Montreal	(2)	$39.40
Toronto	(1)	$2.40
Brantford	(1)	$1.50
London	(1)	$4.30
Brandon	(1)	$2.50
		$57.20

E. J. PHILIP.
WM. A. SWEET.
CHAS. HEAL.
FRED G. MITCHELL.

Moved by Bro. Hunt, seconded by Bro. Blackgrove, that the Convention adjourn till 11 a. m. to give the various Committees a chance to prepare their reports. Carried.

The Convention reopened at 11 a. m.

The Committee on "Constitution and By-laws" presented the following report :

"We recommend amendments to the Constitution as follows ; "

1st. That the preamble of constitution be placed first on the constitution of the Executive council.

2nd. That in article 6, section 1, the word "thereof" be struck off and "ten" be placed therein.

3rd. That in article 12, section 2, the following addition be attached :

"That no subordinate Association receive the password until the Secretary receives their report and per capital tax."

4th. That in article 8, section 6, the duties of the Doorkeeper read as follows: he shall have charge of the door and shall not allow any member to enter or retire during opening, closing or initiatory ceremonies, or whilst a member is addressing the chair.

5th. That heading read "Constitution for Subordinate Associations," that the by-laws be detached from the Constitution, that all printed matter be purchased through the Executive Council.

6th. That article 10, section 1, of the Subordinate Constitution read as follows: "That this Association will authorize a badge as evidence of membership, also pass or travelling card."

GEO. HUNT.
JOS. OGLE.
WM. NORRIS.
G. C. MOORING.
E. F. BRISBOIS.

It was moved and seconded that the report be discussed clause by clause. Carried.

The different clauses were read and adopted.

Moved by Bro. Blackgrove, seconded by Bro. Mooring, that the report be adopted. Carried.

The Committee on "Good of the Order," presented the following report:

"We recommend that button No. 3 design be adopted as our emblem, with suitable lettering thereon, and that the same be purchased through the Executive Head.

That subordinate Associations be recommended to have a clause inserted in their by-laws to the following effect: That the Association accept any legally authorized Stationary Engineer's Certificate in lieu of an examination; that open meetings be held and an educational instructor appointed, also that the Association appoint an Educational Committee to encourage members to read papers on different subjects.

R. MACKIE.
A. M. WICKENS.
J. ROBERTSON.
A. E. EDKINS.
E. J. PHILIP.
W. G. BLACKGROVE.

Moved by Bro. Hunt, seconded by Bro. Mooring, that the report be adopted. Carried.

Under the heading of "New Business," Bro. Hunt spoke on the advisability of the members of the Association investigating the merits of different kinds of steam plants for electric lighting and railway purposes, with the view of finding out which of the many engines would be most suitable under the many conditions met with in electric power stations.

Quite a lengthy discussion took place on the advisability of the members of subordinate Associations taking up the study of electricity as needed by the engineer of the future. Many of the members spoke on this subject, among them Bros. Brisbois, of Montreal No. 2, Bro. Norris, of Hamilton No. 2, and Bro. Mooring, of Toronto No. 1.

Moved by Bro. Philip, seconded by Bro. Heal, that the Secretary of the Executive be instructed to obtain stationery with the crest of the Association thereon, so that same might be bought by individual members for use in their correspondence. Carried.

The convention next proceeded with the election of officers.

The nominations for President were, Bro. A. E. Edkins, Bro. Mackie, Bro. Hunt.

The ballot was taken and found to be in favor of Bro. Edkins, who was accordingly declared elected.

The following were elected without opposition: Vice-President, Bro. Hunt; Secretary, Bro. Blackgrove; Treasurer, Bro. Mackie; Conductor, Bro. Heal.

For Doorkeeper, the nominations were: Bro. Brisbois, Bro. Mooring. The ballot was cast and found to be in favor of Bro. Brisbois.

It was moved by Bro. Blackgrove, seconded by Bro. Heal, that the next annual executive meeting be held in the city of Montreal, the date to be fixed later in August or September by the Montreal brethren. Carried.

Moved by Bro. Hunt, seconded by Bro. Robinson, that a hearty vote of thanks be tendered to the retiring officers for the able manner in which they have performed their duties during the past year. Carried.

Moved by Bro. Robinson, seconded by Bro. Hunt, that the thanks of this Executive be tendered to the members of Hamilton No. 2, for the royal manner in which they have entertained us during this Convention.

Moved by Bro. Philip, seconded by Bro. Brisbois, that this Council convey its thanks to the publisher of the ELECTRICAL NEWS AND STEAM ENGINEERING JOURNAL for his advertisement of our Association. Carried.

Moved by Bro. Hunt, seconded by Bro. Mitchell, that the President and Secretary be a committee to get the proceedings of this convention printed in pamphlet form for distribution in subordinate Associations. Carried.

The President declared the Convention adjourned to meet in the city of Montreal in September, 1893, the date to be fixed later by the Montreal brethren.

THE SEITZ AND LINHART TELEGRAPH.

We know that it would be advantageous to trace Morse lines not along the length of a paper tape, but crosswise, as they do in the Etienne telegraph. A new apparatus using this method of writing is constructed by Messrs. Seitz and Linhart, at Schaffenburg, Bavaria.

The unrolling of the paper is made by an electrical arrangement replacing the ordinary clock movement. This is operated by an automatic interrupter, whose armature draws a band of paper, as its coils are electrified by the current of a local battery closed by a commutator. The principal difficulty in writing across the paper is to prevent the paper from running too far during the writing of a line. The inventors have very skilfully overcome this difficulty. They have added an automatic interrupter to the circuit. The function of the electro-magnet is to apply the paper band against the little writing roller. When at rest, the level of this armature touches a special contact by the intermediary of a little spring that it carries at its lowest end. When the armature is attached by a telegraphic current, it interrupts the local current by which it is displaced at a certain length, because at this moment the spring leaves the special contact. The interrupter acts at the same time for the transmission of a dash or dot. The dots are simply marked upon the paper when a current of short duration passes through the writing electro-magnet; the ink-wheel is not displaced.

Besides the main electro-magnet, they insert into the line a second electro-magnet acting as a relay; but this has a certain inertia, and does not act until it is called upon by the current of long duration transmitting a dash. Its armature closed, then the local battery on the second parallel circuit to that of the interrupter contains four electro-magnets; the latter then attracts its armature, and the writing table placed upon the end of a lever goes across the paper and writes a line.

This telegraph can also be used upon lines with a continuous current. It is necessary to modify somewhat the mechanism. —*La Lumiere Electrique.*

Before any general change in the direction of permanency in the type of steam engineering equipment of electric lighting plants can be expected, says the *Engineering and Mining Journal*, there must be a more general testing of the efficiency of the various kinds of equipment now in use, covering the efficiency of the boiler, as shown by the water it evaporates per pound of coal, of the engine, as shown by its steam consumption per indicated horse-power, and of the combination of the engine and the dynamos, as shown by the electrical horse-power generated by the dynamo in comparison with the indicated horse-power of the engine. It is to be hoped that there will be a series of tests made at the World's Fair of the efficiency of these various elements and combinations, and this should do much toward establishing that permanency of type which has been reached in many other branches of engineering.

Many times little occurrences come up in an engineer's practice where some kind of cement which will stand the heat and pressure of steam can be used to excellent advantage. Perhaps a blow hole in a casting opens up and a stream of steam or water escapes. In such a case it would be most desirable if there was some cement handy which could be put upon the defective spot and would set within a few moments and afterwards remain tight. Many other circumstances often come up where a good cement that would set solid and strong would be found most useful. To be sure, one of the best ways of fixing such things when they occur is to replace the defective by new material, but as this cannot always be done without the expenditure of more time and trouble than is convenient to give it, something that will serve a good purpose instead is desired. A contemporary gives the following recipe for a preparation which, we think, will be found quite useful as we have often used a cement of similiar composition to this. Five pounds Paris white, five pounds yellow ochre, ten pounds litharge, five pounds red lead, four pounds black oxide manganese. The whole is to be well mixed and a little asbestos and boiled oil added. This cement will set hard in from two to five hours and is not subject to expansion and contraction to such an extent as to cause leakage afterwards. Leaks that occur in places which are difficult to get at and remedy, may often be stopped by the application of a little cement composed of the above materials in about the proportions specified.—*Stationary Engineer.*

CANADIAN ELECTRICAL NEWS AND STEAM ENGINEERING JOURNAL

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EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

THE "CANADIAN ELECTRICAL NEWS" HAS BEEN APPOINTED THE OFFICIAL PAPER OF THE CANADIAN ELECTRICAL ASSOCIATION.

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TORONTO BRANCH NO. 1.—Meets every 2nd and 4th Friday each month in Room D, Shaftesbury Hall. W. G. Blackgrove, President; E. Phillips, Secretary, 63 Marlborough Ave.

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BRANDON, MAN., BRANCH NO. 1.—Meets 1st and 3rd Friday each month, in City Hall. A. R. Crawford, President; Arthur Fleming, Secretary.

MONTREAL BRANCH NO. 1.—Meets 1st and 3rd Thursday each month, in Mechanics' Institute, 204 St. James street. Thos. Naden, President; Jos. G. Robertson, 1420 Mignonne street, Secretary.

ST. LAURENT BRANCH NO. 2.—Meets 1st and 3rd Tuesday each month, in Mechanics' Institute, 204 St. James street. Matthias Guimond, President, Alfred Latour, Secretary, 306 Delisle street, St. Cunegonde

NOTICE OF REMOVAL.

The offices of the "Electrical News" have been removed to the Confederation Life Association's new building, Rooms 106, 107 and 108.

MY opinion is, said a level headed citizen of Toronto, that instead of compelling the electric cars to travel at horse car speed, the public should be educated to adapt its movements to a rapid transit gait. Exactly! else the rapid transit idea is a myth.

THE authorities of the School of Practical Science, Toronto, have kindly signified their willingness to place the use of their building at the disposal of the Canadian Electrical Association in connection with the meeting to be held in January. The School contains many objects of interest, the examination of which should add largely to the pleasure and profit of the occasion.

Electricity figures out that the General Electric Company will require to make a profit of $9,000 per day over and above operating expenses to pay dividends which have been guaranteed to stockholders, and declares that in the face of the competition of other concerns this cannot be done.

THE consolidation of the Thomson-Houston, Edison and Toronto Electrical Supply Companies' interests in Canada, foreshadowed in the last number of the ELECTRICAL NEWS, has been consummated. The new company will be known as the Canadian General Electric Co. The capital stock is fixed at $2,000,000. The head offices of the concern will be in Toronto, while the manufacturing will be done at the shops erected by the Edison Company at Peterboro', Ont.

THE rapid introduction of electricity for street railway purposes, made it necessary for the managers of electric roads to place in charge of motors men with practically no training for the position, and this has led to accidents which would probably not have occurred had experienced mortormen been in charge of the cars. The safety of the public and the interests of the electric street car companies both demand that men who are placed in charge of motor cars hereafter, shall first receive the necessary training.

WE commend the following from the New York *Electrical Review*, to those who have not yet joined the Canadian Electrical Association: "We make our membership in the National Electric Light Association pay us," said the manager of a large central station in New York city. "Every paper of a practical nature read before the Association is dissected in our station and all the kinks, short cuts and experiments are tried under the conditions existing in our work. We have made several valuable discoveries in central station practice in this way, and regard our membership in the Association as indispensable."

THE severest test to which an electric street railway could be put will be encountered in the city of Montreal, in connection with the enormous quantities of snow and intensity of frost, which is the usual accompaniment of winter in that locality. It is proposed to cart away the snow and ice from the streets, leaving only sufficient to provide sleighing. The expense of removal, which will be no inconsiderable item, will be borne by the Street Railway Company and the city jointly. Under the new order of things, the citizen of Montreal, will be able to recognize acquaintances across the street, which the accumulation of snow and ice has heretofore made it impossible to do.

IN another column will be found an article descriptive of experiments in the use of electricity for heating purposes, which have recenty been in progress at Ottawa, Ont., together with illustrations of the devices employed. So successful have these experiments been, that the new method of heating is soon to be put to a practical test on an extensive scale. The result will be watched with much interest, more especially in view of the advancing price of coal. A vast waste of money and labor is involved in our present methods of heating. It may be regarded as certain that there will be substituted for them in the near

future a method not less efficient but more cleanly and economical. It is by no means unlikely that electricity will be the chief agent in the reform.

MANUFACTURERS of electric machinery should be careful to see that the persons they send to install apparatus are possessed of sufficient knowledge to enable them to set it up properly, so that it may not prove a source of danger to life and property. For want of this knowledge an electric motor was installed in a Toronto printing office in such a way that when put into operation the machine was burned out and the building badly scorched, while the employees received such a scare as will tend to make them, in future, ill-at-ease in the vicinity of the motor. One of the best means of popularizing electric motors is to take pains to see that they are properly installed.

AT the recent meeting of the Dominion Trades and Labor Congress, held in Toronto, a resolution was adopted recommending that all railway, telegraph and telephone lines should be owned and controlled by the Federal Government; and all gas and electric light plants, water works, ferries and street railway lines should be owned by the municipalities in which they are situated." We fear that those who voted for this resolution did so on the the impulse of the moment, and without a full acquaintance with the subject. Governmental management of public enterprises in this country in the past has not been marked by such economy or efficiency as should warrant the extension of the principle. The same is to a large extent true of municipal management. Beyond all this is the fact that if the most important business enterprises are to be placed under government and municipal control, capital will be driven out of the country.

A DECISION of considerable importance to electric street railway companies, has just been given by the Railway Committee of the Privy Council, arising out of the application of the Davenport Street Railway Co. for leave to cross the tracks of the G. T. R. Co. at Davenport. The solicitors of the G. T. R. and C. P. R. petitioned the Committee to compel the Street Railway Company to stop at the crossings, and to bear the cost of necessary precautionary measures to protect the public at these points; also that the men in charge at each crossing should receive their instructions from the railway company, but should be paid by the street railway company. The decision of the Committee, practically settles the matter on the basis suggested by the railways viz., the cost of the protection of the public devolves upon the electric company and no electric car must approach within 400 feet of a crossing, at a greater speed than six miles an hour.

AN increased number of exhibitors of electrical apparatus, was a noticeable feature of the recent Industrial Exhibition in Toronto; this applies, however, to exhibits of the smaller kinds of apparatus only. So far as arc lighting machinery is concerned, there was only one exhibitor, viz., the Ball Electric Light Co. of Toronto. No doubt the large street railway contracts which some of the manufacturing companies have at present on hand, prevented them from making an exhibit this year. There should be ground for the hope that in connection with the convention of the Canadian Electrical Association next year, there will be such an exhibit in this line as will indicate the progress which electricity has made and is making in the Dominion. We might suggest to the management of the Industrial Exhibition Association, that there is room for improvement in the facilities at present offered to machinery exhibitors. It is to be hoped that that these improvements will be made before the exhibition of 1893.

IF it be true as reported that an electric lighting company in a neighboring city has accepted the renewal of their contract for one year at 23½ cents per lamp for all night service, we can but deplore the causes by which such state of affairs has been brought about. While aware that the company use water as a motive power, this fact is not sufficient to warrant such miserable rates and our prediction is that the city will fail to get good lighting at this figure and the company will find that it cannot afford to give a good and efficient service at such a price. We are inclined to blame past bad service by the company for present unsatisfactory conditions, in view of the fact that the city council tried to pass a by-law empowering them to borrow money and establish a plant of their own, which would have proved to be a foolish and expensive experiment. Right here let us emphasize our remarks on this subject in our last issue, by again calling the attention of those operating electric lighting plants to the fact, that it is imperative that their contracts should be fulfilled in the best manner possible at all times, if they hope for their renewal.

THE handling of the enormous traffic incident to the holding of the Industrial Exhibition was a severe test of the efficiency of the Toronto electric street railway. The completion of the King street line, which was designed to carry the bulk of this traffic, had to be pushed with the greatest possible speed, and when finished there was no time for experimenting. The visitors were flocking in thousands to the city, and it was necessary that the road should be put into practical operation at once. Not only so, but, as already stated, the circumstances required that it should be immediately subjected to the severest possible test. The results have excited the surprise and admiration of all beholders. Hundreds of thousands of passengers, many of whom had never before seen an electric street railway, were transported to the Exhibition grounds and back, a distance of eight miles, without injury to a single individual. We congratulate the management upon such a splendid achievement, which has done much to allay the apprehension excited by some of the daily papers regarding the danger attendant upon the operation of the trolley system. These papers are now forced to admit that with the exercise of reasonable care on the part of the employees of the company and the public, the danger is but little if any greater than under the old horse car system. The adoption of some device calculated to push off the track any obstruction, human or otherwise, which might chance to get in front of a moving car, and a regulation, such as is proposed, to compel the conductor to stop his car on the near, instead of the farther side of street crossings, would tend to further reduce the probability of accidents.

A RECENT number of the London *Electrical Review* comments strongly on a paper published in one of the U. S. electrical journals on the candle power of American incandescent lamps, in which, to use the *Review's* extract, "it is made to appear that so called 16 candle power lamps range in candle power from 8 to 18 by actual photometric tests." While such a state of affairs would be deplorable, we are in a position to know that for efficiency, long life and candle power, there are no lamps manufactured in the world which will excel the lamps made by the principal lamp makers in the United States. We may be permitted to point out to the *Review* that the lamp or lamps, if there were more than one, must have been defective and never meant to be put upon the market as a commercial article. The article continues: "and, further, that American lamp manufacturers seem to divide lamps into two classes, viz, a high efficiency, short lived, lamp for use when current is supplied by contract, and a low efficiency but more durable lamp, for use when current is supplied by meter, and it is suggested that these are supplied to central station managers, and through them to their customers, according to the method in which their current is charged for." The *Review*, in commenting on this, calls it American "cuteness" on the part of the lamp manufacturers and station managers. To get the opinion of a person prominent in electrical matters, and who has had the handling of a great number of incandescent lamps, we submitted to him the article in question asking his opinion on it. His reply in substance was as follows: "I know of but one lamp manufacturer out of the hundred or so in existence in the United States, who makes it a practice to manufacture a short lived, high efficiency lamp, and a long lived low one, and he does not make a point of advertising, as formerly, this specialty, having probably discovered that station managers generally are desirous of pleasing their customers not only as regards amount of light, but also with regard to price. With the general run of electric lighting companies doing incandescent lighting under contract, the customer is charged for his lamp renewals at cost price. Does it not therefore seem reasonable that no station manager who has the welfare of his company at heart will supply his customers with a lamp that will have to be bought over again, as it were, by him,

say after two or three weeks use for ordinary lighting, neither would many customers using the light submit to such an extortion for more than a few weeks. Looking at it from a meter point of view, there are very few station managers who would knowingly purchase a low efficiency, long lived lamp to supply to meter customers for the sake of the few additional hours that such lamps would last. It is decidedly to their benefit to have their meter bills moderate in size and their customers pleased, rather than to have meter bills large, customers growling about the price and declaring that their meter is worthless. We feel positive that it is the lamp manufacturer's main endeavor on this side of the ocean to make an incandescent lamp which will give the proper candle power, with a consumption of current and length of life equal to any made in the world. We know for a fact that he is doing this, and is selling lamps at a low price and making money ; can our neighbors across the water say as much for their manufacturers ?

THERE was a motor exhibited at the Toronto Exhibition which was said to be a mechanical device for the increase of power. The inventor and promoters stated that they had no perpetual motion scheme, but a genuine mechanical discovery by which power was increased. The machine when driven by a ten horse power engine was said to be capable of doing fully thirteen horse power of work. If it could be made to do so much more than the engine driving it, no doubt further improvements could make it do fifteen horse power. Suppose a ten horse power engine driving one of the improved motors, and fifteen horse power is available at the belt from the motor. This belt could drive another motor and the fifteen horse power would then become twenty-two and a half horse power. From this second motor let a ten horse power belt be carried back to a pulley on the shaft of the steam engine, and the ten horse power required at the steam cylinder is brought directly to the shaft, and the steam cylinder may be removed or the steam shut off. The machine will now continue to drive itself, and have twelve and a half horse power to saw wood with or to run a dynamo to light up the room so that all the world may come and see the greatest motor of this or any other age. The perpetual motion idea is evidently not dead yet, notwithstanding all the efforts of schools of practical science and other methods in vogue for teaching men they can only withdraw from the bank an amount equal to that which they have put in, and that without even 3% of interest.

THE construction of the Toronto electric street railway was delayed for several months and a considerable amount of expense incurred by the city, in order to satisfy those who were of the opinion that the storage battery would be an improvement on the trolley system. The result was not unexpected to those acquainted with the subject, in whose minds it was a foregone conclusion that no other system than the over-head trolley could be made successful at the present time. In view of the experience which the city of Toronto thus gained, and of the time and money spent in its purchase, it is somewhat surprising to find that a similar agitation in favor of the storage battery is at present confronting the Street Railway Co. of Montreal. With a view to settling the matter, Mr. James Ross, President of the Company, has made the following offer:—"I will refer the question of the case of the storage battery to a committee of three, to be selected from the leading civil engineers of Canada and the United States, including the presidents of the societies of civil engineers of England, Canada and the United States, and the professors of practical science in the McGill and Toronto universities. If this committee shall decide that the storage battery system is fit to be used for the whole street car service of the city of Montreal I will pay the whole expense of this investigation and donate $5,000 to any charity to be previously agreed upon, provided that the storage battery advocates will agree to do the same should the decision be adverse to their system. I have named the civil engineers to conduct this investigation in order to avoid the suspicion that electrical engineers may be biased in favor of the trolley." It is safe to say that Mr. Ross's challenge to the advocates of the storage battery will not be accepted.

It is reported thrt Mr. Brinkman, of Chatham, will be appointed manager of the Bell Telephone Company at St. Thomas.

"DEAD WIRE" ON ARMATURES.

ALTHOUGH the modern dynamo is very nearly perfect in its construction, both scientifically and mechanically, yet there exists in certain machines some dead or inert material, which cannot be avoided. We refer to what is known as the "dead wire" on drum armatures.

As may be inferred, this "dead" wire is dead as far as practical results are concerned, and is simply a dead load to carry.

This "dead" wire is located at the end of the armature opposite the commutator, and consists of the continuation of the windings of the conducting wire from one side of the armature to the other. It is "dead" because it produces no practical results for the reason that it does not come within the influence of the magnetic field ; it is therefore a sort of necessary evil, because it is, as far as known at the present time, the only practicable means of carrying the current from one side of the core to the other.

In the case of large armatures, when the conductors are of large diameter, or of such form and mass as to render them comparatively inflexible, it is impracticable to continue the windings over the end of the core in the manner adopted on ordinary sized armatures. Some special devices are employed ; such as half-circle segments, discs, etc. In any case the cross-diameter connections cannot be dispensed with, hence the necessity of making them as short as possible so as to reduce the resistance. This is necessary in order that as little energy as possible may be consumed, because the greater the resistance of a wire the more the current strength will be expended in passing through it.

The active wire on drum armatures is located parallel to the axis, and the more wire we can pass through the magnetic field at right angles the better.

The percentage of active wire of the total length varies greatly—from 30 to 60 per cent. That portion of the wire which is wound over the end of the core is not wholly inactive, however, but the electromotive force produced therein is so slight that it has little effect on the general result ; what little electromotive force is produced is due to the fact that these portions of the wire cut the magnetic lines obliquely. (The electromotive force varies inversely as the obliquity of the wire with reference to the field of force.) The greatest electromotive force is produced when the wires cut the magnetic lines at right angles, and none is produced when the conductors pass through the field of force parallel to the lines.—*Electrical Age.*

LINES OF FORCE IN THE FIELD OF A DYNAMO.

Dr. Fleming estimates the lines of force in the fields of the best dynamos at from 6,000 to 10,000 per square centimeter. A definite value must be found for the maximum magnetization of iron ; that is, the number of lines that can be forced through it per square centimeter, with a given magnetizing current must be ascertained. Ever since the investigation by Dr. Rowland of the laws of the magnetic circuit attempts have been made to settle this question. The nature of the iron bears so strongly upon the conditions, however, that it appeared for a long period almost hopeless to arrive at a definite basis for a workable theory. Later researches bearing upon the permeability (magnetic conductivity) of the iron have, however, proved so fruitful that, knowing the nature of the iron, it is possible to predict the number of lines that would result from a magnetizing current of so may amperes in the exciting coils.

From numerous experiments it would appear that the maximum number of lines of force which usually traverse a bar of soft. annealed iron one square centimeter in cross-section is about 32,000. In some of Prof. Ewing's experiments, however, a magnetization under extraordinary conditions, as high as 45,350 was attained. But beyond a certain limit the magnetizing current has to be so relatively enormous that in dynamos even the maximum here stated is almost unknown. There is probably, however, no theoretical limit to the magnetizability of soft iron.

Incorporation has been granted to the External Journal Loose Pulley Company, Toronto, with a capital stock of $50,000 to manufacture wood split driving pulleys, shafting coupling, hangers, etc. Mr. C. T. Brandon is the President.

THE LATE C. N. GISBORNE.

MR. GISBORNE, Superintendent of Government telegraphs brief mention of whose death was made in our last issue, was born in Broughton, Lancashire, England, on the 8th of March, 1824. After having made a tour around the world in 1842, he settled in Canada in July, 1845, and commenced life here as a farmer. In 1847, he left the farm to accept a position in the offices of the Montreal Telegraph Co., and shortly afterward opened the first office of the Company in the city of Quebec.

In 1850, he was appointed chief officer of the Nova Scotia Telegraph Co. While occupying this position, he conceived the idea of constructing a telegraph line, which would bring St. Johns, Newfoundland, into communication with the American continent, and by means of which news from Europe could be received in 48 hours less time. The project contemplated the erection of a telegraph line through a wild stretch of country 400 miles in length, and ultimately the running of a submarine cable across the Gulf of St. Lawrence. A grant of £500 was secured from the Newfoundland legislature, to cover the cost of preliminary surveys; land grants were also obtained, following which the Newfoundland Electric Telegraph Co. was organized.

Financial aid was obtained in New York, and in 1852, a submarine cable was laid from Cape Ray to Prince Edward Island. This cable was the first of any length to be put down in America.

In 1853, Mr. Gisborne's New York backers became discouraged, and left him without means to carry out the project he had undertaken. The creditors of the company had him arrested, and to regain his liberty cost him every dollar he possessed. He still had faith, however, in the success of his idea, and in 1854, renewed his efforts in New York, to obtain the necessary means with which to complete the undertaking. Becoming acquainted with Mr. Cyrus W. Field, who was a civil engineer and railroad builder, he interested the latter in the scheme, which was finally carried out.



THE LATE C. N. GISBORNE.

Mr. Gisborne then, in conjunction with Mr. Field, projected the laying of the Atlantic cable, and it was under his charter that the Transatlantic Telegraph Company first began its operations. After enormous difficulties had been surmounted, the undertaking was finally successfully carried out.

Shortly after, Mr. Gisborne was appointed Superintendent of the Dominion Government Telegraph and Signal Services, which position he held until his death. He was one of the founders of the Royal Society of Canada, and the inventor of a numberof electrical and other appliances.

RATES FOR ELECTRIC LIGHTING.

BY C. W. SWOOPE.

At the present time the price of any commodity is regulated by its demand, the location of the demand from the source of supply and the first cost of manufacture. In most cases the selling price, within certain limits, varies inversely with the demand, the larger the scale of production the less the cost for a given quantity; also the rates for transportation, although varying directly with the distance, decrease to some extent with the amount carried.

In like manner the rates for supplying current for electric lighting are dependent upon similar conditions. The elements that generally do, and should fix the price of supply, are the demand for service and the locality, the latter fixing the price of water and fuel. Considerable disparity exists among the various companies in their rates of service, some of which are no doubt due to the above named elements, but much also, in many cases, to the method or manner in which the rates were determined. In determining the latter, two methods have generally been followed, one by towns and the other by cities. In the first case the method of procedure has been something like this. The matter of the electric lighting for the town having been considered by a few of its prominent business men, from standpoints of convenience, and more especially as an investment, a company with the necessary directors and officers is formed The first step is the selection of apparatus or system to be adopted, a tour of inspection of plants in the immediate vicinity "to see what other people have" is strikingly natural and very proper. This problem having been solved, then comes the question "what rates shall we charge for lighting?" Letters are sent to towns of about the same population, asking "their prices," and from these replies the price is generally determined by averaging the prices charged elsewhere, regardless of their own condition and locality and what is determined by them. It is here where the mistake is made that has caused much dissatisfaction between the company and the consumer in more than one instance; these same men, often times very capable and shrewd business managers, would not think of treating matters of law or building operations in such a manner, yet this evil course is entered upon, and the consequences are: the capital invested is more than would otherwise have been required, the prices for lighting are inadequate, poor returns discourage the investors or expensive lighting becomes unpopular with the public. Current is generally supplied by contract or by meter. The former has many disadvantages and objections, especially for domestic electric lighting, where the price is so much per a standard lamp, as a 16 c. p., or a certain rate per candle power per month or year, when various sizes of lamps are used, as 8, 10, 12 c. p., etc., satisfaction has only been given to stores using quantities of light and for long periods. The private consumer desiring to fit up his house with numerous outlets, for convenience, is charged for the entire candle power, that is, no matter what percentage of the lights are burned or how long used. To remedy this, various complicated scales of prices have been devised, charging for lamps according to their location such as halls, parlors, bed chambers, etc., which, however, is objectionable, as it requires much time and care to keep track of the various sizes and their location, disputes often occurring when the little paper lable indicating the candle power is detached. It seems strange that the candle power, voltage, and watts per candle power are not stamped on the metallic portion of the lamp, instead of being printed on a label and pasted upon the glass only to be wiped or washed off. Electrolytic and electro-magnetic meters for measuring currents have been in use for some time now, and although some imperfections exist in these methods of measuring current, which will no doubt soon be remedied, considerable success and satisfaction have resulted where they are used. They are certainly more accurate than any candle power contract system, and fairer to consumer and station. A consumer naturally wishes to pay "for what he burns," not "for what he can or may burn," and the meter is the only solution of the problem.

Our second method of determining rates, generally followed by our large cities, is accomplished in a more accurate and business-like manner. The best results and the most fair and satisfactory prices have been obtained when the price for supplying electric lighting is based upon the price of gas in the same locality. The latter having been used for some years its illuminating power and cost are well known. If the company would start by furnishing current at the same relative price as gas, they would not be far astray, and, if after some time the price was found to be too high in some localities, it could be readily reduced, it being an easy matter to diminish the price, but an exceedingly hazardous and difficult matter to increase it.—*Electricity*.

A number of Ottawa capitalists, including Messrs. Thos. Ahearn, R. Blackburn, William Scott, J. W. McRae, G. P. Brophy. Thos. Woodman and Peter Whelan, are seeking incorporation as the "Ahearn Electric Heating and Manufacturing Company (Limited)," to take hold of Mr. Ahearn's patent heater, elsewhere described in this paper, and supply heat and light by electricity in all its branches. The capital stock of the proposed company is $250,000.

ARRANGEMENT OF STEAM PIPES.

WE have, from time to time, says *the Locomotive*, called attention to the importance of suspending and securing steam pipes properly and providing for their expansion and contraction. In this article we wish to call attention to a common but dangerous method of connecting boilers with main steam pipes.

Fig. 1 shows the way in which the connection is frequently made, the stop valve being near the boiler, and the pipe entering the steam main below. The action of this argument is as follows: The boiler being out of use, entrained water from the other boilers in the battery, as well as water of condensation, settles in the

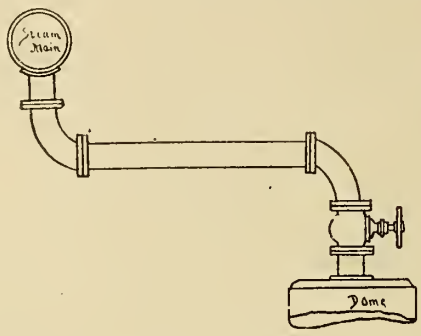


FIG. 1.

space between the stop valve and the steam main. Then, when the boiler is put in use again, in order to prevent any sudden strain from being thrown on the boiler, the stop valve is not opened until the pressure in the boiler has risen slightly above that in the main steam pipe. When it is opened there is a sudden outflow of steam, which raises the water in the connections, throws it against the first elbow, and, if that does not break, hurls it the full length of the horizontal pipe, against the second elbow, and then into the main steam pipe. The shocks so produced are greater than can be imagined by one who has not had experience with water hammers. In one case that came under our observation recently, three elbows were fractured in succession from this cause. When the first one broke the superintendent of the mill considered that there must have been a flaw in it. It was replaced by another which lasted only a few days. A third elbow was put in, with a precisely similar result, and by that time the superintendent had become satisfied that something was wrong with the arrangement of the piping. The defect was pointed out to him, the pipe was re-arranged, and there has been no trouble since.

It might be said that the stop valve should be opened when the pressure in the boiler is just equal to that in the main. This is true, but it is not easy to determine, with any degree of precision, when these pressures are equal, and the engineer very

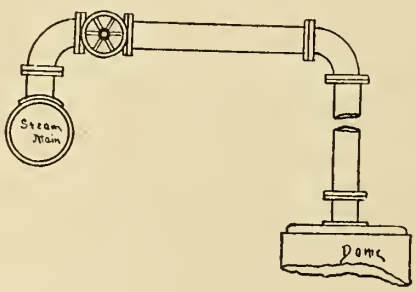


FIG. 2.

properly prefers to err on the safer side, and have his boiler pressure a trifle too great, rather than too little.

The danger may be greatly lessened by putting in a drip pipe. The drip should enter the valve at as low a point as possible, and care should be taken, when the idle boiler is about to be thrown into use, to blow all the water out through this drip pipe immediately before opening the stop valve. If this were carefully attended to each time, the arrangement of piping shown in Fig. 1 should give no trouble, but it is a matter of every day experience to find engineers who perhaps do not fully realize the importance of the drip pipe, growing somewhat careless about it. After they have conscientiously used it fifteen or twenty times there is a tendency to slight it a little and open the main valve before the water is all out. If no trouble results this is apt to fix itself on the man as a habit; and some day, when he is in a hurry, he may pay no attention at all to the drip and open the main valve at once, exposing himself to the danger described above.

It is a far better plan to fix the pipe right and do away with the drip. A proper arrangement of the connections is shown in Fig. 2. The piping passes up above the main steam pipe which it enters at the top; and the top valve is placed in the horizontal part of the connection, and as near the steam main as it can be, conveniently. It will be seen with this arrangement there is no danger of trapping water. The entire connection, from boiler to main, remains dry, and no water-hammer action is possible.

Fig. 3 shows another way of arranging the connections so as to avodi the trapping of water. In this arrangement the pipe enters the steam main at the side, the elbows are done away with, and an angle valve is used to connect the horizontal and vertical pipes. When new work is being put in we usually recommend this arrangement, but if the piping has already been put up, in the

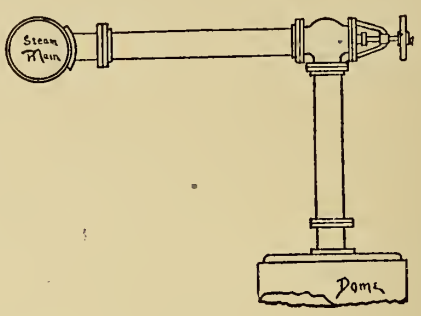


FIG. 3.

manner shown in Fig. 1 or in any similar manner that involves the same element of danger, the arrangement shown in Fig. 2. is cheaper to put up, because it enables one to use the same valve that was in use before.

A POINT ON SETTING A SLIDE VALVE.

SUPPOSE you are called upon to adjust a slide valve on an upright engine 1/32″ lead on top and 1/16″ on the bottom; after ascertaining by the usual means that the eccentric rod connection is the right length, adjust the valve so as to equalize the lead on both ends, then increase the lead 1/64″ on the bottom, revolve the eccentric around on the shaft until you decrease the lead on the bottom to 1/16″; you will then find you have 1/32″ on top. For instance you had 1/8″ on both ends; you increase the bottom 1/64″ by lengthening the rod; you then have 9/64″ lead on the bottom and have decreased the top to 7/64″. You now revolve the eccentric on the shaft away from the crank enough to decrease the lead on the bottom to 4/64″, you will find 2/64″ or 1/32″ on top and 1/16″ on the bottom. If this rule is strictly adhered to it will simplify the setting of valves requiring more lead on the bottom than on the top.—*Master Steam Fitter.*

TRAINING WOULD-BE ELECTRICAL ENGINEERS.

ACCORDING to the *Engineering Magazine* (New York), the the question as to the best course of study to be pursued by young men seeking to gain a thorough knowledge of electrical engineering received considerable attention at the late annual meeting of the American Institute of Electrical engineers. Most of the leading technical colleges were represented by their professors of electrical engineering and physics, and the proceedings, which were quite animated, served to contribute much valuable information on this important subject. In a paper read at this meeting Prof. Owens pointed out that at the present day there were really three distinct classes of electrical engineers—installing engineers, who superintend the construction and operation of lighting and power plants; designing engineers, whose province relates to the construction or manufacture of machinery apparatus, and a third class who are engaged more particularly in laboratory, standardizing and experimental work. He thought that a course of any technical school ought to recognise these distinctions, and that it should be so shaped as to conform to the different requirements of the specialized divisions of electrical engineering. While it is neither desirable nor possible that the courses in the different schools should be alike, it is obvious that much waste of effort might be avoided if the different institutions would observe a certain unity of purpose and treatment. All were agreed that the importance of mechanical drawing and of manual training as factors in elementary education could not be over-estimated. "The practical engineer," said Prof. Jackson, "must be pre-eminently an enthusiast, while he is at the same time a candid and careful thinker."

SOME NOTES ON THE EXECUTIVE MANAGEMENT OF STREET RAILROADS.

By A. K. McKay.

THE importance of this branch of railroad operation will not be gainsaid by any one. Executive ability is born, not bred, and as a manager has this quality so also is his worth. By the executive branch of the management may be understood the whole management of employees, from the officer directly under the manager, to the day laborer on the track; also the management and direction of all supplies bought, promotion of travel, accidents, and the dealings with the municipal government.

The writer will assume that an entirely new road is being built ready for the executive officer to take charge, and will briefly refer to the departments and to the problems to which a manager should particularly apply himself. But before going into details the writer wishes to impress upon owners and directors of street railways the absolute necessity of allowing the manager *full* and *free* control; he should be the absolute and not the nominal head, directing and guiding its policy in every branch. It has been demonstrated too often that a board of directors *cannot* successfully operate a street railway. Choose your man, in whom implicit confidence can be placed and who has the best and permanent interests of the road at heart, whose zeal and experience are known; then allow him to exercise unhampered and unfettered control.

When these powers have been conferred, the manager will begin by appointing his assistants, namely, the electrician and superintendent; these two offices can be combined in small roads. The conductors, motormen, car cleaners and inspectors will be under the superintendent, and should be engaged by him. The engineers, firemen, oilers and linemen will be under the electrician and he should be allowed to engage them. This matter of allowing the superintendent and electrician to engage their own men is a great help to them in maintaining the discipline of the road The men will work better, have more respect, and be more strictly obedient to the man who engages them than to one they recognize as subordinate to the manager. The moment they see that the manager reposes confidence in the electrician or superintendent, the same moment will they accord him additional respect and prompter obedience.

A time-table should be prepared and submitted to the manager, together with a code of rules, and conductor, engineer and car inspector reports. Every day these various reports should be handed to the superintendent and electrician, so that each morning they can in person report to the manager, noting in detail anything which may have occurred the previous day.

Having then thoroughly organized his force, through his two lieutenants, and having gone through and sifted the rules and reports and satisfied himself as to their usefulness and practicability, the manager can turn to the purchasing of supplies. These should all be bought from the manager's office; the superintendent and electrician inspecting whatever comes to their respective departments, recommending or disapproving, together with reasons, in writing, their supplies. In this manner the best of coal, oil, grease, etc., as suited to the exigencies of the occasion, will be secured.

The question of travel will next engage the manager. It is assumed that the road is situated in some city of moderate size where the cars are not overcrowded, and that travel must be more or less created, or at least encouraged. Having made the schedule, and having operated the same for a short while, the conductor reports should be examined. From these can be readily obtained the hours of the day when travel is the heaviest. Extra cars should be run during these hours, and during the lightest hours cars may be taken off.

Of course, on some days of the week travel will be lighter than on others. These should be noted and if possible special attractions should be offered to promote travel. During the summer months this can be very easily done by concerts held in some park or hall at the end of the line. The manager should exercise every ingenuity to furnish attractions of one sort or another which can be obtained without *too much cost*, which shall attract crowds. The writer knew a case in which a manager spent some five dollars on a set of negro camp-meetings, feeding the colored people till they became self-supporting, which was in a day or so, and receiving back some three hundred dollars in car fares during the time the meetings were held. A manager must be quick to grasp the opportunity of carrying the crowds on such occasions, giving full and ample accommodations for riding, as nothing will detract from amusements so much as a poor return service. If he has insufficient car capacity, try to move them in sections, prolonging the entertainment to hold part of the crowd while a portion is being moved.

In winter the same plan should be pursued; a skating carnival, a dance, or a concert in some hall towards the end of the route will prove attractive and increase receipts. Too much attention cannot be paid to this branch, with liberal assistance to any enterprising individual who wishes to open a pleasure ground at the end of the route.

Accidents will happen on the best regulated roads; and only one piece of advice is offered, that is, to compromise. The writer knew of a road which was unfortunate enough to run over a capitalist and kill him. The widow had ample means to fight the company; but by excellent management of the case, it was compromised at *two hundred* dollars! The road should endeavor to pay such claims by tickets, or privileges; actual cash being the last and final resort. Delay is a very potent factor in the settlement of such cases, and the collection of evidence *at the time* may be *invaluable*. The rules should state, that in case of an accident, the conductor and motorman should get the names and addresses of *all eye-witnesses*, and make a written statement of the affair to the superintendent, who in turn will report to the manager.

Every manager will be called upon to cope with the city fathers, either in getting a new franchise, a side track, or placing a pole. A general piece of advice which may prove useful is to meet and conquer them individually before being called before them collectively. Count noses, only be sure they are counted correctly. A manager who requests a grant from the council and who does not consult them individually before presenting the same, is not wise, and will oftener be denied than granted the privilege.

An executive officer who is thus equipped, with a pair of good lieutenants, the best men obtainable as employees, a ready and facile ingenuity for promotion of travel, and a mild form of diplomatic ability in dealing with the aldermen, cannot fail to render a good report both for himself and for his road.—*Electrical Engineer.*

TELEGRAPH COMPANY'S LIABILITY.

IN the case of The Western Union Telegraph Company vs. James, the Supreme Court of Georgia held that while the contractual limitation of sixty days for presenting a claim for damages against a telegraph company does not apply to a statutory penalty for delay in delivering a message it does apply to all claims for special damages and operates not alone against the sender of the message, but against the receiver of it, where the message in question relates to the business of both parties and is a reply to a previous message sent by the receiver. The court said that where the damage done to the latter by delay in delivering the message was in breaking up negotiations for the sale of cotton of a low grade and preventing a sale which would otherwise have been consummated, the measure of damages would be the difference between the price which would have been realized by the sale contemplated and the value of the same cotton on that day in the market; or if there was no market for such cotton at the place where stored, its value at the nearest market to that place at which it could be disposed of, together with the expense, if any, of transporting it thither: that if it had then no market value anywhere, the measure of damages would be the contract price less the best price which could afterwards be obtained for it on the first day it could be sold, and the expense of holding it until that day; that presumptively, in the absence of proof to the contrary, cotton had some market value on every day in the year; and that consequently a claim for damages would be practicable, and might reasonably be required, within sixty days from the time the message was sent, delivery having been made on the following day.

We are pleased to notice that the business of Messrs. Patterson & Corbin of St. Catherines, has developed to such an extent as to render it necessary for them to enlarge their works to almost double their former capacity. The Company manufacture a new style of vestibule electric car, which is almost a duplicate of the vestibule railway car.

SPARKS.

A patent was recently granted to Mr. W. T. Jennings, late City Engineer of Toronto, for a rail for street railways.

Mr. A. Shaw, proprietor of the Nanaimo. B. C., Electric Light Co., has found it necessary to make an assignment.

Wm. M. Boomer, owner of the horse street car line at Windsor, proposes to extend the same and adopt the electric system.

The City of Toronto has received from the Toronto Street Railway Co., during the last year, as mileage, the sum of $60,000.

A new company has been incorporated at Lansdowne, Ont. to build and operate a telephone system between that town and Rockport.

The Edison Co. have purchased the plant of the Citizen's Electric Light Co., Windsor, Ont., and together with the Reliance Co., will operate the plant.

It is said to be the intention of the Department of Railways and Canals at Ottawa, to connect the several lock stations of the Rideau Canal by Telephone.

A syndicate has purchased the Ward mill and water power at Smith's Falls, and will use the power, estimated at 300 horse power, exclusively for electrical purposes.

The Royal Electric Co. has been given permission to lay rails for an electric street railway, to enable them to connect their different works and to test electric cars.

Mr. Mullan, of the Ottawa Street Rairway Co., is the inventor of a self lubricating gear for trolleys, which it is claimed does away with the necessity of frequent oiling.

A by-law to give the telephone company exclusive privileges for the period of ten years, after having received its first reading in the Winnipeg City Council, was filed.

By the first of November, the Montreal Street Railway Co. expect to have in operation 31 miles. An all night service on the principal routes, has recently been inaugurated.

We are informed that H. H. Brown, No. 5 Moulton Ave., Montreal, has been granted a patent for the latest improvement on a non-inflammable and weatherproof electric light wire.

A new power house and car stables are being erected at Brantford, by the Edison Electric Co. It is said to be the intention of the company to conduct a general lighting business.

Mr. Smith, proprietor of the Electric Light plant at Digby, N. S., has decided to dispose of the plant and business to Messrs. John Daley and G. T. Lettney and Bro., of that place.

Incorporation has been granted to the Rat Portage and Keewatin Electric Street Railway Co., with a capital stock of $300,000. The Company proposes to supply light, heat and power.

The Dominion Electrical Manufacturing Co., of Toronto, is seeking incorporation for the purpose of manufacturing electrical apparatus. The capital stock of the Company will be $40,000.

The National Electric Light Co., of Eau Claire, Wis., have the contract to furnish dynamos for the supply of current to 2000 16 c. p. lamps for the Citizens' Electrie Co.. of Rat Portage, Ontario.

James McMillan, employed as lineman by the Hamilton Electric Light and Power Co., while constructing wires on a roof, fell a distance of fifty feet and sustained severe, though it is hoped, not fatal injury.

The Canadian Whitney-Hoyt Electrical Instrument Co. has been formed, with a capital stock of $300,000, to manufacture and sell electrical instrnments. The headqnarters of the company will be Manchester, N.H.

The Nova Scotia Power Co. announces its intention to construct an electric street railway from the deep water terminus of the Intercolonial Railway at Halifax, to the south end of the city, by way of Water St.

The Eastern Electric Co. will push forward as rapidly as possible the equipment of the whole street car system of St. John, N. B. It is expected that the electrie cars will be started on the road in about three months.

It is understood to be the intention of Mr. Bickerdike, of Montreal, to construct electric railways in St. Cunegonde and St. Henri, suburbs of Montreal, together with a suburban line to Lachine and St. Anne's, next year.

Incorporation has been granted to the Arnprior Electric Light and Power Co., Arnprior, Ont., to furnish electricity for commercial purposes and to manufacture electrical apparatus. The capital stock of the company is $30,000.

The Winnipeg Street Railway Co. have filed a bill against the Eectric Railway Co., alleging that the new company has been trespassing on their rights, and requesting that it be not allowed to run cars. A long and bitter legal fight is anticipated.

The Bell Telephone Co. are said to have offered to pay the city of Brantford, $450 per year, for the sole right to do a telephone business in the city. The company also agree to make concessions respecting the use of poles, the price of telephones, etc.

A new electric street railway has been completed and put in operation in Yarmouth, N. S. The new road is two miles long, and the equipment is said to be first-class in every particular. Yarmouth is the first town in the Maritime Provinces to adopt electric transit. All the stock of the company is held by citizens of the town.

In St. Hyacinthe, Que., the voting on the by-law to purchase the apparatus of the Electric Light Company resulted in its defeat by 158 votes to 53. In Nanaimo, B. C., a by-law providing for the purchase at $40,000 of the electric light plant has passed its second reading in council.

John Douglas, of this town, has a necktie pin in which a real electric light of half a candle power. The current is from a small battery carried in the vest pocket. The light which is set among the jewels gives a very pretty effect and can be turned on or off at will.—Truro *Headlsght.*

An action has been entered against the Harbor Commissioners of Montreal, by the Royal Electric Co., for refusing permission to carry out a contract held by the insolvent firm of Craig & Sons, the assets of which firm were purchased by the Royal Co. Damages to the amount of $13,000 are claimed.

The Bell Telephone Co. at Ottawa, expect shortly to take possesion of their new exchange. A multiple metallic switch board, designed for a present capacity of 1,500 subscribers and an ultimate capacity of 3,000 subscribers, is being constructed for the exchange, at the Company's shops at Montreal.

There is a dispute as to the title of the land along the Canadian bank of the Niagara river upon which a company was empowered by the Provincial Government to construct an electric road. The Dominion Government lays claim to the title of the land, and has recently had it surveyed. Pending the settlement of the dispute, the undertaking will not be preceeded with.

An agreement has been reached between the Bell Telephone Co. and the city of Guelph, by which the Company is given the exclusive right, for five years, to erect poles on the streets. In return for the privilege, the Company are to connect their wires with several of the outlying villages, and to allow the city to stretch fire alarm wires over their wires and on their poles, and give the city a metallic service.

On the Ann street extension of the Ottawa Electric Street Railway, a steel trolley wire has been used instead of copper, and the trolley wheel, instead of revolving, is fixed. To give the proper conductivity, the cross wires are of copper. It is believed that the steel wires will withstand the constant friction better than copper, although it is expected that the current will not be maintained at so high a standard.

Work is progressing rapidly on the addition to the Toronto Electric Light Company's station. A huge chimney stack has been erected, the foundations for the building and steam plant are approaching completion, and a battery of boilers is in position. In short, the most difficult part of the undertaking is finished, and in a comparatively short time the Company's central station facilities will be double what they now are.

The Electric Light and Tramway Co., of Victoria, B. C., whose power house was recently destroyed by fire, entailing a loss of some $80,000, have lost no time in re-building and purchasing the necessary equipment, to enable them to resume business. The new building, composed of brick, stone and iron, is in course of erection, and it is expected that business will be resumed almost immediately. There was an insurance of $45,000 on the property which was burned.

Notice is given of application for letters patent to incorporate the Central Electric Light Company, of Montreal, capital $200,000. The following are the names and addresses of the applicants: Louis Perrault, printer; Honore Beaugrand, journalist; Trefile Berthiaume, journalist; E. M. Lovelace, merchant; Odilon Dupuis, merchant; Jos. Melancon, notary; Jos. A. Rodier, doctor; Alphonse Raza, architect; Charles Berger, contractor; Jos. Brunet, contractor; James Cochrane, contractor; Louis Couisneau, contractor, and Emmanuel St. Louis, contractor, all of the city of Montreal. The said Louis Perrault, Honore Beaugrand, Treffie Berthiaume, E. M. Lovelace, and Odilon Dupuis, are to be the first directors of the company.

The Street Railway Construction Co., Limited, with a capital stock of $80,000, has recently been incorporated. The objects of the company are the construction, building and equipment and contracting for the construction, building and equipment of street railway lines, and of the apparatus and supply of motive power therefor, by electricity or otherwise. The pro, motors of the new Company are as follows:—Marshall D. Barr, of Toronto-electrician; Henry W. Darling, of Toronto, electrician; Robt. Bickerdike, of Montreal, merchant; John Torrance, of Montreal, shipping agent; Chas. Morton, of Montreal, merchant; Herbert M. Linnell, of Montreal, electrician; Alex. J. B. Close, of Toronto, real estate agent; Sam. Insull, of New York, electrician; John Muir, of New York, electrician; and Albert W. Atwater, of Montreal, advocate.

The Supreme Court of Appeals of West Virgina held, in the case of Woolwine's Adm'r vs. Chesapeake & Ohio Railway Company, reported in the *Railway and Corporation Law Journal*, that a person who, without invitation, visits a telegraph office merely for the purpose of paying a friendly call to the operator, which office is owned and occupied by a railroad company for its purposes and convenience. and which is located on its land and near its track, from which occasional messages are sent and received for outside parties for pay, visits said office as a mere voluntary licensee, subject to the concomitant risks and perils; that no duty is imposed upon the owner or occupant to keep its premises in safe and suitable condition for such visitors; that the owner is only liable for such willful or wanton injury as may be done such licensee by the gross negligence of its agents or employees, and that where there is no controversy in regard to the facts or inferences that may be fairly drawn therefrom, the question of negligence is one of law for the court to determine.

WHAT ELECTRICIANS MEAN BY "EARTH."

By Sydney F. Walker.

Perhaps no science has a more puzzling nomenclature than electricity, Electrical engineers have named their units after the great men who have worked in their ranks, and by so doing have perpetuated the names of those men, as possibly nothing else could have done. But the names themselves, volts, ohms, amperes, farads, &c., are sad stumbling blocks to those who would like to know a little of the science, but who have not time to make a set study of it.

But of all terms used by electrical engineers, probably "earth" is the most puzzling.

Even the trained electrical engineer, the man who has spent a large portion of his life in the service of the science, has sometimes to think what is meant by "earth," in a particular case. How, then, can those who have not studied the subject follow its different meanings?

In the early days of electric science, before we knew anything like as much of it as we do now, and when its use was confined almost entirely to experiments shown in the laboratory, we had not these difficulties.

In those days "earth" meant earth, and nothing else. Electricity being looked upon then as something very much like water, only that it flowed in wires instead of pipes, it was natural to refer to mother earth as the great natural reservoir of electricity. As it is well known, you can always procure water if you dig down far enough in the earth, and the earth will always soak up or carry off, more or less readily, all the water that may descend on it. So, too, the early electricians found that by connecting one side of their frictional machines to earth—in this case the floor of the room—they could go on generating electricity as fast as it was discharged from the prime conductor. They found, too, that connection to earth in the form of their own person was fatal to a certain class of experiments.

Later on, also, when it was discovered that an electric current sent through a wire carried above the ground would return to the place of generation through the ground, the same idea prevailed. Old text books tell the student to regard a galvanic battery as an apparatus something like a pump drawing water from a well, able to draw an inexhaustible supply of electricity from the ground at one place, and to pour electrictty into the ground, *ad infinitum*, at another place.

A study of old text books, and even some modern ones, will play rare havoc with the ideas held about "earth" in connection with electric lighting supply, for instance.

In charging the electrophorus, for example, the student is told to put the brass plate to "earth;" to discharge it, in fact, by touching it with his finger. And the plate was, and is, so discharged. Fancy trying to discharge a 10,000 volt transformer in that way.

About the time of the advent of the telephone, it began to be realised that the part played by "earth" as a return for telegraph circuits was not exactly what it had been supposed. It was gradually recognized that the return current passed through the surface of the earth's crust, using what ever paths might be open to it, very much in the same way that the current passed in the wire forming the other portion of the circuit above ground. The only difference between them was that, while the locality of the current passing in the wire was fairly certain, that of the current passing through the ground was not so certain. A portion of the return current from Manchester to London, for instance, might go round by way of Glasgow or Aberdeen, if there happened to be a path for it by either of those routes.

The development of the telephone, with its often troublesome "cross talk," which was traced to earth connections, in a great measure gradually drove the old ideas of the reservoir quite out of the field. Especially was this so when it was reported from America that messages sent in one telephone wire had been heard on another telephone wire separated six miles from the first, the only possible connection being the earth's crust to which both wires were connected.

Gradually it came to be recognized by practical men that "earth" consisted of the conducting matter, such as moisture, mineral veins, &c., held in the earth's crust, with any metals buried there. But then came another trouble over this question of earth. How did "earth," affect a lightning discharge? and what was "earth" for a lightning rod? Surely the old idea held good here? Lightning came down the copper rod to "earth," and was discharged. Unfortunately, lightning does not always behave in this proper fashion. Prof. Oliver Lodge has rearranged our ideas upon this point. He has even maintained that the "earth" our forerunners worshipped is rather a drawback than otherwise. Some of us still believe in "earth" for lightning rods, though we prefer it of a different form usually to the old patterns; our views in the matter being based upon what we have learnt as to the use of the conductors in the earth's crust and in connection with other apparatus.

And, now, when we are congratulating ourselves upon having at last reached the dignity of supplying electric light from generating stations, just as gas has been supplied during the memory of the oldest of us, comes "earth" again, but it means something quite different, and yet the same.

Now, if a man standing on the ground touches an electric light wire carrying a high tension current, and receives a smart shock, he is said to have "earthed" the line, or the electric light service through his body. So, too, when a naked copper wire, used for delivering current to a series of arc lamps, touches an iron lamp-post, and thereby interferes with the working of the lamps beyond, it is said there is "earth" on. Again, when the possibility of users of electric light, who are supplied by high tension currents, getting shocks is discussed, we are shown various devices for putting the circuit to "earth," should such a contingency arise.

But in these cases the meaning of "earth," though sufficiently the same as in those previously noticed to warrant the retention of the name, is really quite different. "Earth" is not necessary in these cases, as it was in the early days of electricity, with frictional machines. Nor do we use "earth" to save us one cable, as we do with telegraph wires, and as we may with telephone wires.

It is true that in a recent lawsuit over some electric lighting patents "earth" was brought very much in evidence; but it was shown that what was meant was an uninsulated metallic return cable, and that the cable might be insulated if you like.

It is also true that certain electric tramways in America, and in this country, use what they call "earth" for their return current; but they do not mean "earth" in the old sense—they mean a set of conductors, the rails that happen to be on the ground. In electric lighting work we get as far away from "earth" as possible. To any but electrical engineers of considerable experience a recent report that has been made by a Board of Trade inspector must be exceedingly puzzling. Shocks were obtained from the water service in a house in St. James, and a gas meter had one of its sides, which rested against the damp wall, eaten through by electrolytic action. The water and gas service is referred to as being several volts above the conduit in which the cables of the Electricity Supply Company were laid; and further on it is stated in one part of the report that earth, which should be absolute zero of electrical potential, had a difference of 190 volts with one of the supply mains, the normal pressure of the service being 220 volts? What does all this mean? What does "earth" mean here?

In connection with electric light supply, where two insulated cables are used, "earth" may be taken to mean any conductor, such as water and gas pipes, iron conduits, &c., that may be present in the ground, and which are all more or less all in electrical connection with each other, by reason of the moisture which is held in suspension in the soil, as well as in bricks, wood, and even in the hardest stones present.

But, and here is the point where this "earth" varies from what we called "earth" before. These masses of metal, damp ground, &c., should have no connection with the electric lighting service at all; they are at absolute zero, because they are, or should be, absolutely neutral. Whenever they become connected, either directly or indirectly, with any portion of the electric lighting circuit, they are no longer at zero of electrical potential, because no longer neutral, and form part of the electric lighting system, just as if they had been regularly calculated for and laid as the cables were: and the danger, when such a connection exists, is not from any reservoir having been suddenly tapped, as a water-bearing fissure may be in a mine, but in the suddenly bringing within the influence of the electrical pressure created at the central station, of a system of conductors that are of uncer ain and varying measurements, and quite beyond the control of the engineer.—*London Electrical News.*

SPARKS.

Mr. O. Higman, of Ottawa, has been appointed by the Dominion Government Inspector of Electric Lighting and is at present engaged in formulating rules for governing the installation and operation of electric plants.

At the Windsor Hotel, Ottawa, Ont., recently, the Mayor and a number of other notable men were invited to partake of a banquet, the components of which had been cooked to a nicety in an electrical oven, located at the car sheds, where the company afterwards had the pleasure of inspecting it. A local paper gives the following description of the cooking apparatus:—"The oven is of brick, about six feet wide, and somewhat deeper, and about six feet high. In the lower part of the oven are two Ahearn heaters fed by a wire from the Chaudiere Electric Light Company, giving a power of fifty volts. There is no water about this system, as in the house heating. It is just the dry heat. The maximum warmth produced by the two heaters is literally sufficient to roast an ox, so intense is it, but of course can be modified away down, and that easily. The beauty of the new system is that everything so cooked is done equally all through. There is no scorching in one part and half-done-ness in another part. To avoid loss of heat by opening and shutting of the oven door in cooking there are at the side of the doors peepholes, as it were, protected by heavy plate glass. The progress of cooking can thus be watched without disturbance to the articles being cooked."

With the assistance of the Provincial Secretary the town authorities have reached an agreement under which the Port Arthur electric railway will be extended to Fort William. The agreement provides that Fort William West will have a railway in full operation by next autumn. The whole length of the line will be eight miles, and a certain number of cars will run continuously from one end to another every day. Certain provisions were made as to Fort William taking a joint ownership if it so elects, and certain protective clauses were put in guarding Port Arthur's interests in the event of the portion of the road within the limits of Fort William being taken over by the municipality. Port Arthur is to have the right to run the road for 20 years from Dec. 1, 1893. At the end of that time Fort William may buy the property of the railway which lies within its own limits at a valuation to be settled by arbitrators. The railway plant and property are not to be taxed by the council of Fort William. Until Fort William pays for an interest in the road, the road is to be managed by the council of Port Arthur, who shall be entitled to the whole income derived from the railway. The line when completed will be a great boon to the citizens of Fort William and the large number of people who have occasion every summer to pass through that locality.

ELECTRICITY IN MINING.

I AM on record as being of the conviction that a successful electric percussion drill is the key to the general introduction of electricity in mining operations, writes Nelson W. Perry in *Electricity*. As the statement thus stands it might be misleading, and I wish at this point to make myself quite clear. It is a fact that at the present time considerably less than one per cent. of all the mines operated employ power drills of any kind, or feel the need of them, or, in fact, would use them if you furnished them a completely equipped plant free of charge. To send solicitors among these, would therefore be not only useless, but a waste of time and substance. there is, however, another class of mines where power drills are not used but might be used to advantage. Here, intelligent presentation of the case might result in business, but how is our tenderfoot electrician or solicitor to distinguish between the two? But among those mines which do use power drills how useless it is to attempt to induce the management to put in an electric plant which will do but a portion of the work, whereas it already has a steam or compressed air plant that will do it all. The representative of the electrical company offers to light the mine with electricity, and will guarantee to work the pumps, hoists and drills by the same agency, but he knows nothing of pumping, hoisting or drilling, and his ignorance is at once apparent ; and as to lighting, that is a luxury, and our western brother is unused to luxuries.

But if a few of these mines which can use power drills could be equipped with a perfectly satisfactory electrical drill, the entering wedge would have been driven, and the moral effect upon others would indeed be salutary, and in my opinion do more for the general introduction of electricity to mines of all classes than any other one thing. But the fact is that the electric drill has not yet given entire satisfaction. The manufacturers have put it on the market somewhat prematurely, making claims for it from shop tests which have not yet and cannot be borne out by continued use. If less had been claimed, greater satisfaction would undoubtedly have been given ; but when the claim is made that a certain amount of work can be done with an expenditure of 4 H.P., and in practical work but a fraction of this is accomplished with 7 H. P., the reputation of the machine is seriously damaged. Manufacturers must understand that shop tests of 12 or 20 minutes or an hour's duration give little indication of the practical working of a machine.

Some of the objections urged by practical men against the electric drills of the present day are that they are too heavy and heat up to an abnormal degree. Both of these objections must be met before the electric drill will be a practical success. We know of one instance in which a lot of electrical drills of a prominent make were thrown out because they would not clean the hole well. This was not an electrical difficulty, but probably entirely due to a faulty bit. It emphasizes, however, what I have been contending for all along, viz : the importance of employing for all mining work—both in the shop and in the field—of men who know their business. It will not do to copy after accepted practice unless the conditions in both cases are exactly the same. A drill bit that will clean at 300 strokes per minute may choke the hole at 600 strokes, or vice versa ; and one which will work satisfactorily with a true reciprocating motion may not give satisfaction when this is departed from. Attention to details of this kind by men who thoroughly understand their business, I am sure, would have saved the electric companies much trouble.

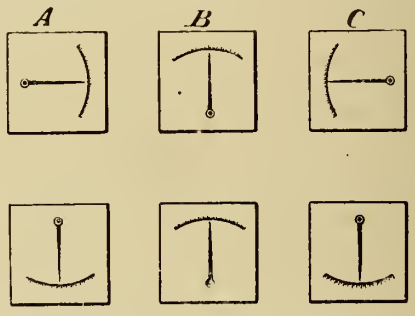
Then as regards water power. While there are but few electricians who are also mining engineers, the proportion who are also hydraulic engineers is still less. The opinion that to run a plant by water power it is only necessary to find the water power, install a wheel and connect the latter to a dynamo, has already resulted in many disastrous failures in the mining regions. In the first place the water powers are often gauged at the wrong time of the year and an estimate made which is far in excess of the minimum, which for steady running must always be regarded as the maximum. This is due to two things : first an ignorance of the business; and second, to taking the measurements at the wrong time of the year, when the water supply is not at its minimum. Throughout a large portion of our western country the proper time to gauge the streams is in midwinter, and early in the morning when everything is frozen up tight. Those familiar with the western mountain streams know that the volume of water carried by them is sometimes double at 4 P. M. what is it at 6 or 7 A. M., but the difficulty is that at the season of the year most favorable for gauging in other respects, the localities are often almost inaccessible on account of the snow. Then in regard to the proper regulation of the wheel. This is of the utmost importance, and nothing short of automatic regulation will answer the purpose. A lack of attention to this caused the utter failure some years ago of one of the largest electrical plants for mining purposes that has ever yet been erected.

In the case above referred to, a river had been diverted from its usual course in order to enable the company to wash the gravel for gold. The water of the river furnished the motive power for wheels which drove the dynamos, and current was carried for about 12 miles to a series of motors located along the exposed river bed. These were employed to operate cranes to remove the large boulders that were in the way of these placer miners. Occasionally as one of these boulders was being lifted it would slip from its fastenings, thus suddenly removing the load both from the motor and from the dynamo. The result was that either one or both burned out, and this occured so often that the plant was declared a failure, and finally abandoned entirely, having discredited electricity in that section of country to such an extent that it feels the effect of it to this day.

PLACING OF AMMETERS.

Prof. C. W. Pike gave the result of some experiments with a Weston Ammeter, made to show the effect of two or more instruments on each other when placed near together.

It is much handier when making tests to have the instruments arranged as near together as possible, yet they must not be placed so as to affect the correctness of the readings. Several



When two instruments only are used place them as A and B or B and C. When three ; place in this position.

tests were made to ascertain a safe distance for placing so as not to affect the other instrument or be affected by it, and several interesting points were brought out.

The outline sketches will make clear the correct positions for the least error, although the instruments need not set square with each other if placed over a foot away ; i. e. one foot between the nearest points of their frames.

TELEPHONE COMPANIES LIABILITY.

IN the case of The Southwestern Telegraph & Telephone Company vs. Robinson, reported in the Washington *Law Reporter* the Circuit Court of Appeals for the fifth circuit decided that a telephone company which for several weeks permitted its wire to remain suspended across a public highway, a few feet from the ground, was liable to a traveler who came in contact therewith during an electrical storm, and was injured by a discharge of electricity which had been attracted from the atmosphere, since the electricity would have been harmless except for the wire. The court said : "The duty on the part of the telephone company was clear to prevent its wire from becoming an obstruction on the highway. Under the circumstances shown the defendant in error might have been hurt by coming in contact with the wire of the telephone company, and injuries to the defendant in error might have resulted independent of the fact that the wire at the time was loaded with a charge of electric fluid from the clouds and storm then prevailing. So that it is difficult to see how this verdict could be disturbed even if the contention of the plaintiff in error is correct, that the electricity with which the wire was charged at the time was the proximate and immediate cause of injury to the defendant in error, for which the telephone company cannot be held responsible."

THE POSSIBILITIES OF THE TELEPHONE AS FIRST VIEWED BY THE INVENTOR.

THE following interview took place recently between Prof. Graham Bell, the inventor of the telephone, and an old newspaper acquaintance on the staff of one of the Boston papers :

"Did you appreciate, Professor Bell, the possibilities and tremendous scope and influence of the telephone when you described your invention to me in 1876?"

"No, I did not ; but I was much more sanguine of its success than were my business associates at that time. Like all inventors I saw what no one else could see at that early day. I saw a fortune for some one and hoped that it might be for me. But really, you newspaper gentlemen place my fortune too high. You are responsible for a too exalted impression in the mind of the great public as to the colossal proportions of my estate. I am said to be a millionaire, and people charge me for everything as if I were a millionaire. The telephone has made large fortunes for many men who were courageous enough in the infancy of the invention to invest in the enterprise, but the amount of money made by telephone companies is not so large as the public supposes.

"Has the telephone reached its highest stage of improvement did you say? Oh, no ; I sincerely believe that its possibilities are much greater than any of us imagine. What we must now do is to discover some method by which to simplify the complicated system which has grown up and surrounds my original invention. The telephone proper is the same to-day that it was 15 years ago, when the first line was run from Somerville to the office of Stone & Downer, the State street bankers and brokers. Mr. R. C. Downer, now president of the Broadway National Bank, was really the first to use the telephone, and when I recall the crude manner in which the line was then constructed, I am surprised that it worked at all.

"In the summer of 1876, when you so kindly published a sketch of my invention, and when the Boston *Journal* told the world about my achievements, I could then talk as far as North Conway, N. H., and south to New York. The night when you were obliged to decline an invitation to meet myself and Sir William Thomson, the celebrated English electrician, who has since been made a peer of Great Britian in recognition of his invaluable contributions to science, I had secured the use of the line of the then Mutual Union Telegraph Company, and we conversed with New York, but, of course, the conversation was not so easily carried on as it has been since the construction of what is known as the metallic circuit.

"At the outset we experienced a difficulty in 'calling up' people at the other end of the line, and $50,000 were expended in merely developing a 'call bell.' To do that it was necessary to use an induction coil, or two high resistance coils of fine wire at either end of the line, making four in all. That necessitated a new transmitter, for originally the hand telephone was used as a transmitter and receiver, and the new transmitter called for more resistance coils and a battery at either end of the line. And thus addition after addition has been made, while the telephone principle remains the same as it was originally."

"The public is disposed to grumble at the prices charged for the use of telephones, and think that because the company is doing such an enormously large business that it ought, therefore, to reduce rather than increase, the rates. The fact is, that the telephone business is unique in this respect. It costs more to do a large wholesale than a retail business, and is less remunerative. It is difficult to convince the public of this, but it is nevertheless, true. To meet the demands of the public expensive additions have been made. The 'call bell' was a necessity, but it cost money to introduce it. A transmitter was a necessity, and that cost money. Improvements have been made in many directions. Every genius has been encouraged to invent something that would enhance the value of the telephone to the public, and that has cost money. In fact, the increase in expenditures in perfecting and adding to the original invention have been, not in arithmetical, but in geometrical proportion. The original charges were not sufficiently high ; consequently, it has been necessary to increase the amount, and unless some device shall be discovered whereby the expenses can be reduced it will be necessary to make a further increase."

"Americans are averse to the tollage system. They prefer to pay a lump sum and to use the telephone as often as they wish, for all sorts of purposes. What is the result? The business man, who has occasion to use the telephone many times a day pays no more, in most cases, than the man who only actually requires it two or three times a day. A great deal of useless to and unnecessary talking is done every day over the telephone. Servants gossip over it to their friends ; people call up their neighbors many times when they would not do so if they were charged a certain sum every time they did so. If the tollage system were introduced the number of calls would be reduced ; it would require fewer employees to transact the business, fewer wires would be necessary and in a thousand and one ways would reduce expenses, while the men who did need the telephone frequently for business purposes would pay for it.

"The telephone, as at present constructed, needs the open air to obtain the best results. To use wires placed underground a metallic circuit will be necessary, similar to the one used now on long distance lines. To place the wires underground and to make a metallic circuit, which means to use two wires where one is used at present, will materially increase the expenses of the company, and the public must pay for the luxury. As the number of wires is increasing rapidly it is evident that they must, ere long, be buried.

"To simplify the telephone opens a wide field for inventors, for it is in that direction that we must turn. Pay a visit to the central office in Boston, New York or any other large city, and you will be astonished at the complex system which has grown up almost unnoticed within a few years. There is a labyrinth of wires such as no outsider ever dreamed of. The telephone is so simple in itself and the people have become so familiar with its use, that they would be astonished if shown a modern switchboard. It cost $150,000 to construct the switchboard for the central office in New York city, and if you were to see it you would be surprised that it could be constructed for even that large sum.

"Of course, I am not speaking now from the standpoint of the business manager of the telephone. I am merely a stockholder ; I have nothing to do with the business management ; but it is patent to me and to others that the problem to solve now is, How can the telephone business be simplified and expenses reduced without impairing the efficiency of the service? It is needless to say that business will increase. New subscribers are clamoring daily for the service, and this means more wires, or better facilities for using what we now have."

THE TELEPHONE INSPECTOR.

HE apparently was a visitor from the rural districts who was totally unacquainted with city ways. He entered, says a Chicago paper, one of the offices at the city building and finally attracted the attention of a clerk, who rather gruffly inquired : "Well, what is it? What can I do for you?"

"Where's your telephone?" asked the caller, taking a survey of the room.

"Over there."

Without saying another word the caller walked across the the room, timidly took down the receiver, placed it to his ear, and stood for a minute as still as a statue, evidently listening and waiting for the mysterious instrument to "say something" to him. Then he carefully hung up the receiver, glanced around the room and noticed that the face of every clerk was stretched out of its normal shape by a smile of generous proportions. Again he returned to the attack. After listening as before, he tapped on the transmitter several times. Again he waited. Then he glanced about him, put his lips close to the 'phone, and said quietly—very quietly, "Hello!"

This was too much for the amused clerks to stand, and after a hearty chorus of laughter one of them kindly volunteered to show the old man how to operate the new-fangled talking machine.

"Hang up the receiver just as you found it. Turn that little crank at the right, which rings the bell. Then take down the 'phone, place it to your ear, and when the central girl answers tell her——."

The old gentleman slowly turned, and gazing long and steadfastly on his young friend, remarked, in that same, sad, sweet voice.

"Say! Don't get gay, now. I'm the inspector, and I'm just testing your telephone."

TRADE NOTES.

The Toronto Electrical Works report themselves very busy on contracts for the Toronto Street Railway Company, for whom they are making the cut-out boxes, switch boxes and trolley wheels. Business generally they find very good and improving. Owing to the demand they have increased their machinery list and space to meet the requirements of a growing trade.

Messrs. Darling Bros. have made recent sales of Claussen clutch pulleys as follows: Hobb's Hardware Co., 1 36 in. x 12 in. clutch pulley; Wm. Clendenning & Son, Montreal, 1 25 h. p. clutch coupling; R. White & Co., Montreal, 1 60 in. x 12 in. clutch pulley; 1 36 in. x 10 in. clutch pulley; 1 24 in. x 8 in. clutch pulley; 1 50 h. p. coupling; Standard Drain Pipe Co., St. John's Que., 1 44 in. x 12 in. clutch pulley.

F. E. Dixon & Co., manufacturers of leather belting, of this city, have received an order from the Toronto Electric Light Co. for two enormous leather belts for the addition to their works on the esplanade. These belts are to be 33 inches wide, double thickness, and 260 feet long. F. E. Dixon & Co. have already supplied to this company four large double belts, 36 to 38 inches wide, averaging each over 100 feet long, one of which has been in steady use for over 7 years.

The Ball Electric Light Company report the following recent sales:—Mount Forest Electric Co., 500 light alternating plant and installation; Citizens' Telepbone and Electric Co., Rat Portage, Ont., 1,000 light altenating incandescent dynamo and station apparatus; Imrie & Graham, Toronto, combination motor and incandescent lighting plant, 50 lamps; E. Hood & Co., Toronto, hoisery manufacturers, combination motor and incandescent plant, 50 lamps; Messrs. Geo. Hees, Son & Co., Toronto, window shade manufacturers, electric motor; Messrs. Anderson & Godard, Ottawa, Ont., electric motor; Hart & Co, stationary manufacturers, Toronto, electric motor.

The St. John's Electric Light Co., of St. John's, Newfoundland, whose station was completely wiped out in the recent conflagration, have completed a new brick station on a much larger scale than their old one. This is equipped by John Starr, Son & Co., Ltd., of Halifax, who have contracted with the Electric Light Co. for the supply of two Leonard-Ball Compound Engines of 100 h. p. each, two 50 light arc dynamos and one 1200 alternating incandescent dynamos, as well as the wires and supplies. The dynamos were made by the Royal Electric Co., of Montreal, and will be in operation in a few days. The Messrs. Starr have installed a plant of the Lahmeyer system in the machine shops of James Angell & Co., St. John's, and are about completing another of the same system for the new bakery establishment of Messrs. A. J. Harvey & Co. The Starr Co. are also doing a large business in "Unique" Telephones, of which they are sole manufacturers. The principal advantage claimed for these, over other instruments lies in the transmitter, the adjustment of which does not depend on any springs or screws; the adjustment of this transmitter is all done in the manufacture, after which no further attention or adjustment is required. This is claimed to be the only transmitter that fulfills the above requirements and it is certainly a strong point in its favor both for exchange and private use. They are handsomely gotten up in different styles for exchange and warehouse purposes. The Valley Telephone Co. of Nova Scotia, after six months satisfactory test of these have extended their lines throughout the Annapolis Valley, a distance of 85 miles and have now 65 of the "Unique" standard telephones in use with good prospects of largely increasing that number. Messrs. Starr sell these instruments outright at a very low price and will be pleased to communicate with telephone companies or private parties wanting telephones.

PERSONAL.

We had the pleasure of a call a few days ago from Mr. H. C. Whitney, agent for the Crocker Wheeler Electric Co., of New York, who is here with the object of extending the Company's business in Canada.

Our congratulations are hereby extended to Mr. A. M. Wickens, who recently resigned his position as chief engineer and electrician of the Toronto *Globe* to assume the duties of a similar, but more important position, in the new Legislative Buildings, now nearing completion in Queen's Park.

PUBLICATIONS.

The contributions to the October *Arena* are varied, interesting and able. The *Arena*, besides being the most fearless and aggressive of our reviews, is always varied and exceedingly interesting. It combines the intellectual wealth and profound thought of the serious review, with the entertaining qualities of the popular magazine.

Alex. Anderson's electrical works, Adelaide St. Toronto, were severely damaged by fire a week ago.

Mr. Samuel St. Jaques, head clerk C. P. R. Telegraph Company, at Ottawa, was waited on by the leading newspaper correspondents of the city and presented with a handsome diamond pin on the occasion of his approaching marriage to a Brockville lady.

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Insulation Guaranteed wherever used, Aerial, Underground or Submarine.



In a letter from the Inspector of the Boston Fire Underwriters' Union, he states: "A thoroughly reliable and desirable Wire in every respect."

The rubber used in insulating our wires and cables is especially chemically prepared, and is guaranteed to be water-proof, and will not deteriorate, oxidize or crack, and will remain flexible in extreme cold weather and is not affected by heat. The insulation is protected from mechanical injury by one or more braids, and the whole slicked with Clark's Patent Compound, and special extra finish, which we have now adopted for all our solid wires as an extra weatherproof protection, and also preventing chafing and abrasion, which is water, acid, and to a very great extent fireproof. Our insulation will prove durable when all others fail. We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph and Electric Lights from stock. Cables made to order. We are now prepared to furnish our Clark Wire with a white finish for ceiling cleat work as well as our standard color.

Clark Joint Gum should be used for making waterproof joints. This is put up in half-pound boxes, in strips about one foot long and five-eighths inch wide, and when wrapped about a joint and pressed firmly it makes a solid mass. **For railway** and **Motor** use, we make all sizes of stranded and flexible with Clark insulation.

We guarantee our Insulation wherever used, Aerial, Underground, or Submarine, and our net prices are as low, if not lower, than any other first-class Insulated Wire. We shall be pleased to mail Catalogues with terms and discounts for quantities.



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HERBERT H. EUSTIS, President and Electrician.

SPARKS.

The Crosson Car Works at Cobourg, are manufacturing 20 electric cars for the Montreal Street Railway.

The Brantford Electric Light Co. has agreed to accept 3⅓ cents per lamp per night for 35 lights under a yearly contract with the council.

The new central station of the Guelph Gas and Electric Co., went into operation on Sept. 18th. The building is a most substantial one, and in point of equipment in said to rank in the first-class.

At the instance of the Bank of Montreal, the sheriff of Essex has been appointed receiver of the Windsor and Sandwich Electric Railway. The Third National Bank of Detroit is said to have a claim against the road for nearly $50,000, and the Bank of Montreal a claim of $3,000.

A new power station for the Eastern Electric Co. at St. John, N. B., is in course of erection. It will be built of brick similar in design to the present station, which it will adjoin. It will be 35 ft. by 50 ft. in size, two stories high, and the size of the combined buildings will be 130 ft. by 50 ft.

The inaugural ceremonies in connection with the opening of the Winnipeg Electric Railway, were attended by great enthusiasm on the part of the citizens. The first trip was successfully made with about three hundred passengers aboard. The company carried passengers the first day free of charge. At a meeting of representative citizens a vote of thanks was passed to the company in recognition of the energy displayed in the construction of the road.

A new company has been formed for the purpose of endeavoring to secure the right of operating electric cars in the City of London, Ont. The company has made a proposal to the City Council, which has been met by a counter proposal from the existing company, which under a city by-law, have the practical monopoly of certain streets until the year 1925, and have the first claim to extend their lines on these and other streets. Action has been deferred by the council, pending a complete proposal from both companies.

The Eugene Phillips Electrical Works, as assignee of William Henry Sawyer, of Providence, have been granted a Canadian patent for an electric cable, consisting of a series of insulated conductors, braided loosely together with respect to each other into tubular form, each conductor being thereby held apart from its adjoining conductor, practically surrounded by the air occupying the pores and interstices of said fibrous filling, whereby a high insulation resistance and a low inductive capacity is maintained for the said conductors, and means for centrally supporting the conductors of said series and for maintaining them in position.

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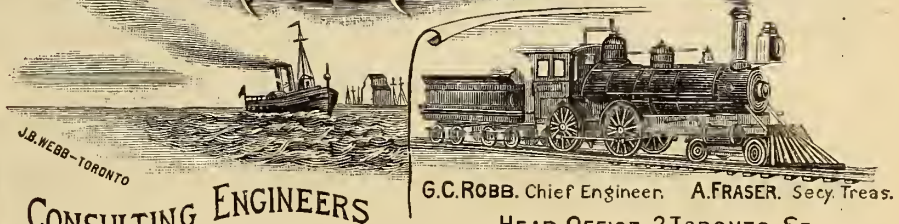
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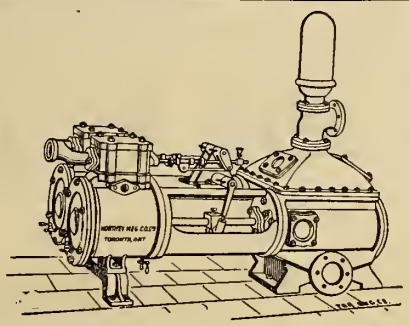
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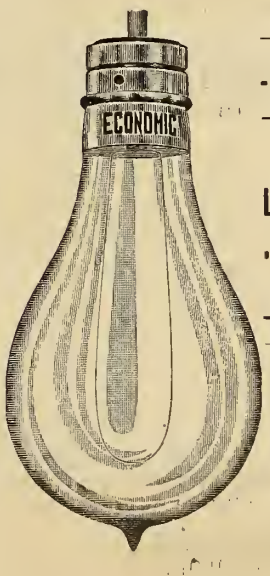
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"Juggernaut" is not such an inappropriate title for the trolley car after all. In India the benighted heathen in the dark days of the past deliberately cast themselves beneath the ponderous wheels. Here in the full light of the nineteenth century, and in Christian Canada, the same thing is done. There is, however, this marked difference in the impelling causes: in India the sacrifice was due to religious fanaticism; here it is the result of fool-hardiness.—Toronto *News*.

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in the form of a large sized lithograph, in eight colors, with key to same, can be had by sending your address with twenty cents in postage stamps, to Geo. H. Heafford. G. P. A., Chicago, Milwaukee & St. Paul R'y, Chicago, Ill. As the supply is limited, applications must be made early. Should the supply become exhausted the postage stamps will be returned to applicant.

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IT HAS A CHRISTIANIZING INFLUENCE WHEREVER IT REPLACES

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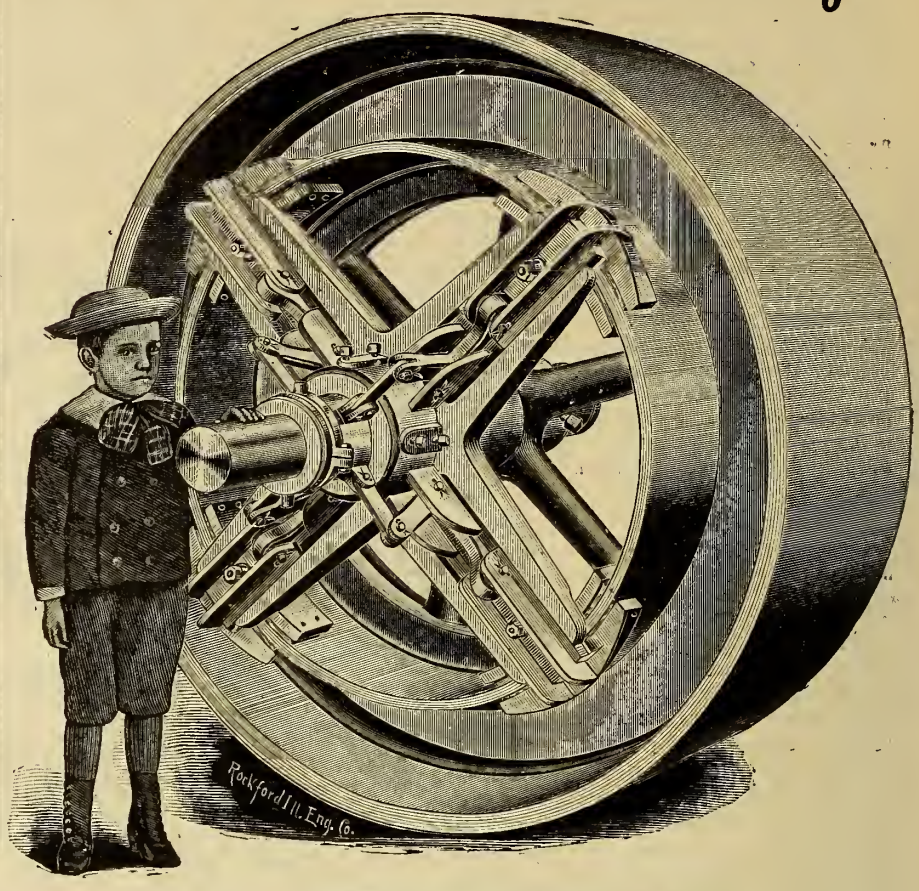
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COPPERINE?
ITS REPUTATION IS GOOD,
AND HUNDREDS OF GOOD MEN SAY SO.
ALONZO W. SPOONER, · · PORT HOPE, ONT

COPPERINE

Superintendent's Office, Water Works Dep't,
TORONTO, January 6th, 1891.

ALONZO W. SPOONER, ESQ.,
Port Hope, Ont.

DEAR SIR: I am pleased to say that after nearly three years' constant use day and night, on our largest engine, your Copperine has stood its work well. I have not had to renew any of the heavy bearings yet, so I consider that speaks for itself. I am pleased to recommend it to any one in need of metal to stand heavy work.

I am, yours truly,
J. C. FERGUSON,
Chief Engineer Toronto Water Works.

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Headquarters for Electric and Dynamo Belting.

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The Berlin Electric and Gas Co.
The Woodstock Electric Light Co.
The Manitoba Electric and Gas Light Co., Winnipeg.
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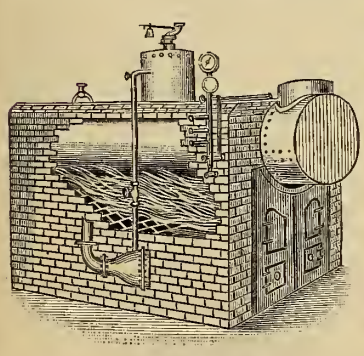
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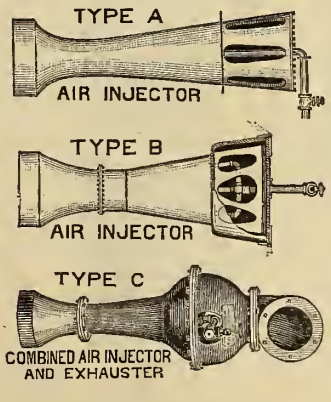
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DEAR SIR,—We have had in use for some time, your Combined "Air Injector and Exhauster" and with pleasure we state that it is giving us the most complete satisfaction. Regarding the saving in fuel, we we e burning, before using the "Injector," two tons soft coal per week, at a cost of $9 00; after we put the Injector in, we burn two ton hard coal screenings per week at a cost of $2.00 making a saving of $7.00 per week, which speaks for itself. We have a much cleaner and better fire and far less trouble in keeping steam. We consider your invention a boon to all parties using steam boilers. Wishing you every success, we are, Yours truly, (Signed) THE CANADIAN OILED CLOTHING CO.
per S. Henderson, Manager.

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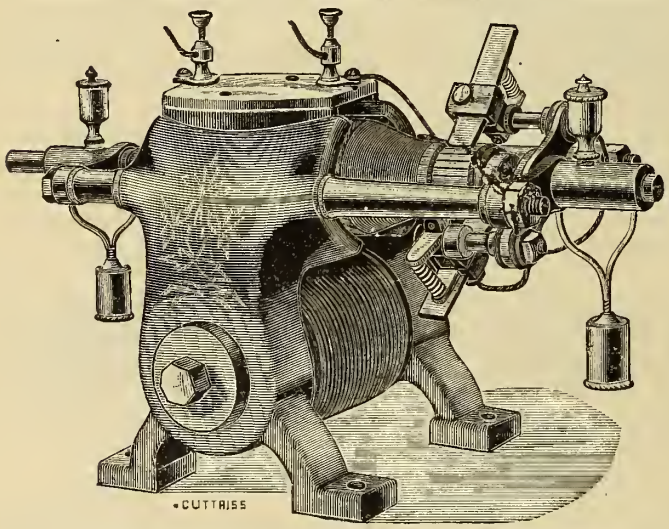
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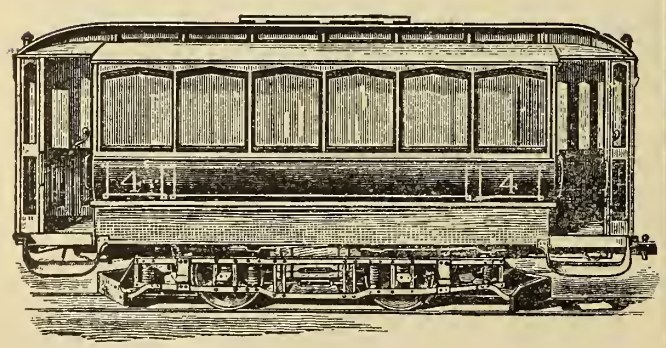
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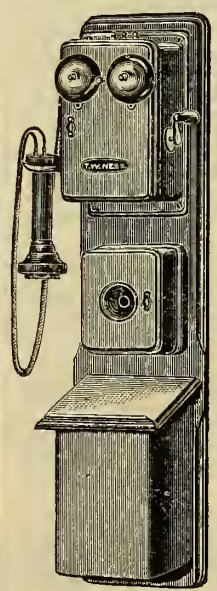


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STE. JULIE, Sept. 5th, 1892.

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DEAR SIR,—We are happy to state that your telephones and switches are giving us good satis-tsfaction. We have three sorts of switches and we find yours far preferable. There is now about forty of your telephones in operation on our line. Every one works well, and we intend to use no other. Yours very tru y,

THE MEGANTIC TELEPHONE CO.

Write us when you want anything electrical.

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CANADIAN

ELECTRICAL NEWS

AND

STEAM ENGINEERING JOURNAL.

VOL. II. TORONTO AND MONTREAL, CANADA, NOVEMBER, 1892. NO. 11.

THE GUELPH ELECTRIC LIGHT COMPANY.

THE Guelph Electric Light Company has been doing business for a little more than five years, and so rapid has been the development of its business that three times during that period increased accommodation has had to be provided for its requirements. The last move in this direction was made early last spring when the company determined upon erecting a new building, which would meet its present and future necessities. This new building took the form of an addition to the buildings heretofore occupied by the company. The old buildings originally did duty as a flouring mill, being known as "Allan's Mills." They are situated close beside a branch of the Speed river, and in proximity to the two railway stations.



NEW CENTRAL STATION, GUELPH ELECTRIC LIGHT COMPANY.

Considerable difficulty was experienced in obtaining a good foundation for the new building as the site, originally the river bed, had become filled up with decayed vegetable and other material of an elastic nature. The foundation, which is of stone built in cement, is about 4½ feet in thickness, and is carried to a considerable distance below the surface of the ground. There are two stone piers supporting the superstructure, and a number of others supporting the engines and shafting.

The whole building is of stone, the walls varying in thickness from 27 inches at the basement, to 22 inches above the dynamo room. The buildings are irregular in shape, the size of the new main portion being 45x63 feet, and of the old portion, 42x63 feet. The height of the ceilings is 7 feet clear in the condensing room. and 10 feet 6 inches in the other stories.

On the second floor, used as engine and oil rooms, there are oak posts resting on stone piers, supporting the upper floors ; The dynamo room floor is constructed of 1¾ inch pine, supported by 14 feet 6 inch x 14 inch joists, which in turn are supported throughout their entire length by trussed girders. Where timbers come adjacent to one another or to the piers, sufficient space is provided to prevent vibration by contact, a point which was insisted on by the engineer.

The walls are built in cement and plastered on the inside ; the ceiling is lathed and plastered on the roof boarding between the rafters, making the roof, in the opinion of the underwriters, fire proof. The roof of the newly erected part of the building is shingled, the shingles having been dipped in mineral paint, and afterwards painted over their entire surface. A wire tower, 14 feet square, occupies the north corner of the building.

The extension of 42x63 feet above referred to, used for boiler house, coal room, store room, repair shop and wheel house, is only one story high, and is roofed with iron.

The machinery has now been in operation about a month, and it is considered that during that time the building has been subjected to as great a strain as it is likely to be called upon to endure at any time in the future, owing to the fact that there has been more vibration than there will be after the machinery, shafting, etc., has been got into perfect working order.

Some particulars concerning the nature of the plant and the manner in which it is arranged will no doubt be of interest. The motive power consists of both steam and water. The water is brought a distance of about fifty yards from the river Speed by means of a stone raceway, which passes right through one end of the building and enters the wheel house at the south corner. The head of water is 14 feet. There was originally in this wheel house, an old penstock, 12x5 feet ; this has been replaced by a new one 12x14 feet, two-thirds of the space required for which had to be blasted out of solid rock, the space around the water wheels had also to be deepened in the same manner, to allow of the free exit of the water.

There are two turbine water wheels, each 33 inches in diameter, of the Little Giant pattern ; one of these is a new wheel which has taken the place of a 17 inch wheel.

The volume of water varies considerably at different times in the year, and the amount of available power varies from 120 to 30 horse power. While the writer was inspecting the wheel house, the drive was started up, and an opportunity afforded of noticeing how smoothly and noiselessly the wheels operate. When water is abundant, the smaller of the two engines with which the station is furnished, is used as an auxiliary to the water power, and as governor of the speed of the water wheels.

The boiler room contains two boilers, each of 75 horse power capacity. These boilers are encased in brick work.

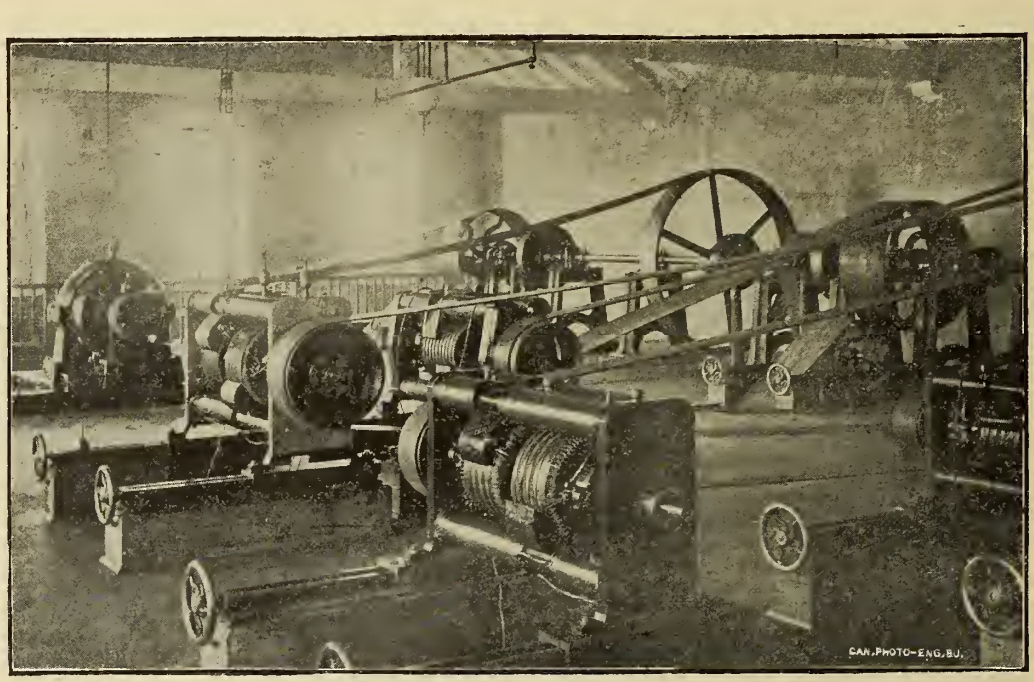
The basement of the newly constructed building is occupied by the condensing apparatus, and is divided from the race by a 4 feet wall. The supply of water for condensing purposes is drawn from the race into a brick tank, and from this tank the

condensers draw their supply; there is also a brick tank for receiving the condensation and water for the condensers, and from this the water supply for the boilers is pumped. There are two condensers and two pumps, the pump connections being so arranged as to supply one or both boilers. The floor of the basement is of pressed brick laid on edge.

An unusual appliance in electric light stations is here to be seen in the shape of a gas meter. The building is piped throughout for gas, which is used by the employees when the electric plant is shut down on moon light nights.

The engine room contains a Wheelock cross compound engine of 150 horse power capacity. This engine is mounted on a solid stone foundation extending down 9 feet below the basement floor. The driving wheel is 13 feet diameter, and 22 inch face; there is also a single cylinder condensing engine of 100 horse power, with a fly wheel 11 ft. 6 in. diameter and 20 inch face, the foundation for which corresponds to that of the larger engine. This engine was the one formerly used, and was moved from the old station. There is a counter-shaft driven off main shaft for operating the pumps and condensers. Adjoining the engine room, and separated from it by a 36 inch wall, is the oil room.

The dynamo room contains four arc and one incandescent dynamos, viz., 75 light, 35 light and 25 light Ball machines, a 50 light Reliance machine and a 500 light Royal alternating incandescent machine. The 50 light Reliance and 65 light Ball dynamos are used to supply current to the street circuits, and the smaller machines to furnish current for commercial business. These dynamos are belted to a line of shafting extending from end to end of the building; each dynamo is driven from a clutch pulley, and can therefore be operated independently or in conjunction with all the others.



View of Dynamo Room, Guelph Electric Light Company.

The switch board has been erected in the north corner, beneath the wire tower, and is fitted with the usual current indicators, etc. The engine and dynamo rooms are connected by call bells and speaking tubes.

The millwright work and power plant were supplied by Messrs. Goldie & McCullough, of Galt, and the belting by the J. C. McLaren Belting Co., of Montreal.

The architect who designed and superintended the construction of the building, is Mr. John Day, of Guelph.

As most of our readers are probably aware, the electric light and gas interests of the city are under one control. The president of both companies is Mr. D. Guthrie, Q.C., M.P.P., and the vice-president, Mr. Richard Mitchell. Both of these gentlemen have held similar relations to the gas company from the time of its inception, twenty-two years ago. The management of both companies is in the hands of Mr. John Yule, who has filled the position of manager of the gas company most satisfactorily during the last 21 years. Mr. C. J. Jordan, the electrician in charge of the plant, has also been with the Electric Light Co. from its inception.

The company is a most enterprising one, and is now in possession of one of the most substantial and best arranged central stations to be found in the Dominion. It is their intention, we understand, shortly to install a power generator to furnish electric power for manufacturing purposes; the opening for business in this direction appears to be very promising.

An external view of the station together with a view of the dynamo room, are presented herewith.

IN RECOGNITION OF DEPARTED WORTH.

Hamilton, Oct. 7th, 1892.

Editor Electrical News.

Sir,—Hamilton Association No. 2, C. A. S. E., at its regular meeting held October 7th, adopted the following resolutions:—

"Whereas it has pleased the Almighty in his great wisdom to remove from us our late Brother, Douglas S. McKenzie, and

"Whereas this Association wish to recognize his many stirling qualities, therefore it is

"*Resolved*—That a fitting tribute be paid to the memory of the departed, setting forth that in lamenting his removal from amongst us, we mourn for one who was worthy of our most sincere esteem;

"*Resolved*—That we offer our heartfelt condolence to the bereaved ones in this their time of deep affliction, and most earnestly beseech them to seek consolation in their bereavement from our Heavenly Father, who in His great wisdom has seen fit to remove from them a beloved father and husband, always remembering that He doeth all things well;

"*Resolved*—That Hamilton Association No 2, C. A. S. E., extend their heartfelt sympathy to the family of the deceased;

"*Resolved*—That the Charter be draped for the period of 30 days as a tribute to the memory of the departed Brother, and that these resolutions be placed on the records of this Association, and a copy be sent to the family of the deceased Brother, also to the mechanical press for publication.

Wm. Morris,
E. C. Johnson,
R. Mackie,
} Committee.

CANADIAN ELECTRICAL ASSOCIATION.

The executive, realizing the advantage of taking time by the forelock, have set about making arrangements for the January meeting.

The Secretary is in correspondence with certain members of the Association in the various departments of the electrical field, regarding the preparation of papers for the approaching meeting, and the consent of some has already been given. It is hoped that no one who has been asked to assist in this way to make the meeting a success, will decline to make the attempt, except under circumstances which would make compliance impossible.

A full meeting of the executive will be held a few days hence for the consideration of this and others matters.

The new power house of the Toronto Street Railway Co. and the Toronto Electric Light Company's new station, will, it is expected have arrived at completion by the first of the new year; these with the new Bell Telephone Exchange, and the headquarters of the local electrical manufacturers, will well repay a visit of inspection.

The Executive will welcome suggestions from any member of the Association which will be likely to promote the success of the coming meeting or the general interests of the Association

SUGGESTIONS TO ENGINEERS ON TENDING DYNAMOS—ELECTRICAL TERMS EXPLAINED.

Place the oil-catchers under the drip of the dynamo bearings, and never allow them to overflow on the floor.

Keep the floor of the dynamo room swept clean, so that no nails or other small pieces of metal can be drawn into the armature.

Never use or leave iron or steel tools near the machine, while at work, as these are also likely to be drawn into the armature if left too near it.

Oil cans made of copper or zinc are best for use about electrical apparatus.

Never allow oil to accumulate on the armature or shafts of the dynamo.

When the wires coming out of the shaft to the commutator become bare from cleaning, they should be recovered with kerite or okonite tape, or gum cloth, and shellaced, and allowed to dry for about eight or ten hours before being used.

If the shellac on armature bobbins or field magnets becomes worn off, these parts should be reshellaced.

A good bellows will be of service in getting dirt out of the crevices of the armature, and around the commutator and rockers.

If the rocker springs are fastened to a wood base, see that the screws which hold them are kept tight as the wood dries.

See that all thumb screws in the binding posts are kept screwed down tight on the wires. Special care should be exercised in regard to this in the case of incandescence machines.

In placing brushes, take pains to clamp them firmly in position, allowing them to rest squarely and evenly on the commutator. Be very careful not to screw down one side of the clamp tighter than the other, but clamp them evenly, so that both edges of the brushes will be held in place.

The clamps holding the brushes must be perfectly clean, so as to make good contact.

Brushes must bear on the commutator with a reasonable pressure, not too hard, nor so lightly as to allow them to flap or chatter. Occasionally, by accident or otherwise, the brushes will get bent, or sprung, and bear too lightly on the commutator. This condition of affairs is always attended with many sparks, and a very rapid cutting, or wearing of commutator segments. In fact, segments may be worn out in a few days, in this way.

If brushes are perfectly straight when put into the clamps, sufficient pressure will usually be obtained.

In an arc light, or high tension machine, if the brushes are rocked too far forward in the direction of rotation of the commutator, the sparking will quite disappear, but the lights will go out occasionally, each extinction being attended by a few very long sparks on the commutator. This trouble may be corrected by rocking the brushes backward a short distance. If brushes are moved too far back, there will be sparking, and a consequent diminution of light in the lamps, and occasionally extinctions of the lamps, similar to those which occur when the brushes are too far forward.

The proper point for the brushes is as far forward as possible, so as to make the sparks small, and yet back of the point where flashing will occur. In low tension, or incandescence machines, the brushes should be adjusted to show no spark, or only a very minute one, otherwise the wear on the commutator and brushes will be very heavy.

Too much oil on the commutator will cause sparks similar to those which appear when the brushes are not properly adjusted.

When brushes are worn nearly through, clip them off squarely at the worn ends, and move them up to the same position as before.

Cleanliness is absolutely necessary to the successful operation of an electric lighting plant. Too often the salesmen of manufacturing concerns give the impression that an electrical plant will almost take care of itself, and that it does not matter where you put it, whether in some out-of-the-way corner, on a shelf, or anywhere, so that it is not in the way. It is not reasonable to expect this of a dynamo machine, any more than of any other fine piece of machinery. Treat your electrical apparatus fairly; give it a location that shall be as clean as possible; grant it some attention, and you will be better satisfied. Poor and dirty oil will cause hot bearings, rapid wear, etc., and is, of course, much more expensive in the long run.

The commutator is a very important part of a dynamo, and should be given special care. It is well to wipe it off frequently with an oiled cloth, and whenever the machine is shut down, carefully brush off any particles of dust or copper which may have collected about the connecting wires, or other parts of the commutator. Should your brushes be of the style composed of a number of wires, soldered or bound together at one end, you will find that they have a great tendency to collect dust, copper filings and oil, which must be cleaned out. If they are attended to immediately after shutting down the dynamo, boiling water will generally clean them nicely. If, however, the oil and dirt are allowed to become dry and hard, it may, perhaps, be necessary to soak the brushes in kerosene oil for several hours. Care should be used in handling these wire brushes to avoid bending, as when bent, some parts of the brush do not do their work, and others are obliged to do much more than their share.

There are some places about a dynamo where oil will do more harm than good, as, for instance, the connections of the fields, and in and around the armature. It will sometimes work its way into the latter place, if care is not used to prevent same. In time oil is apt to rot the insulation, and the constant collecting on this sticky surface of dust and metal particles, tempt the current to break through the rotten insulation, resulting in a burned-out magnet, armature bobbin, or perhaps the entire armature.

Contacts of all kinds should be examined occasionally to see that they are bright and clean, as poor contacts make high resistance, and hence call for more power. They are also liable to heat up sometimes to a dangerous degree, this heating sometimes being so great as to cause a fire.

It is hardly necessary, we presume, to mention the fact that to obtain a clear and steady light from arc lamps, the carbon rods, as well as all other working parts of the lamps, must be kept perfectly clean, and in condition to work freely and promptly. The contact points in the cut-out mechanism should always be bright, so that in case they are called into action, a good firm contact will be made. A clean globe may, perhaps, not be absolutely necessary to the proper working of a lamp, but it certainly looks much better and offers no obstruction to the light.

No sooner has a dynamo been installed in a factory, or, we may say that as soon as its installation is completed and negotiations opened, we begin to hear about amperes, volts, ohms, megohms, etc., etc. It may, therefore, be of interest and profit to consider, briefly and simply, the meaning of these terms, as, when they are clearly understood, other matters are grasped more readily.

E. J. Houston, in his "Dictionary of Electrical Words, Terms and Phrases," states: "The ampere is the practical unit of electric current. Such a current (or rate of flow or transmission of electricity) as would pass with an electro-motive force of one volt, through a circuit whose resistance is equal to one ohm. That is to say, a current of the definite strength that would flow through a circuit of a certain resistance and with a certain electro-motive force. Since the ohm is the practical unit of resistance, and the volt the practical unit of electro-motive force, the ampere, or the practical unit of current, is the current that would flow against unit resistance under unit pressure or electro-motive force."

The ohm, as mentioned above, is the unit of resistance, and the volt the unit of force or pressure. A very simple and easy way to fix in one's mind these terms and their meanings, is to take the common illustration of the flow of water through a pipe. We will assume, for convenience, that we have a pipe one inch in diameter, and, say, five feet long, offering to whatever liquid is to be put through it, a friction of resistance of one ounce. We We now wish to put through this pipe one gallon of water, and therefore must havea certain amount of pressure to accomplish this result. Let us say that it requires a pressure of one pound to push the one gallon of water through the pipe mentioned, the friction resistance of the pipe being one ounce. Transpose this case into an electrical question, and it would be about as follows: The one gallon of water would represent one ampere of current. The friction resistance in the pipe would represent one ohm, and the one pound pressure would represent the electro-motive force (e. m. f.) necessary to drive the one ampere of curreut through a given length of wire having a resistance of one ohm.

The term megohm is formed simply by the addition of the prefix meg, or million, meaning, therefore, one million ohms.—*Scientific Machinist.*

CARE OF STEAM BOILERS.*

By Albert E. Edkins.

This is a subject which is (or should be) of deep interest to all engineers, not only for our own safety and our employer's property, but more especially for the protection of our fellow employees and the general public against loss of life and limb.

I have often thought that this matter does not receive from us that just and careful consideration that it should.

There might be much said or written on this subject in connection with the construction, material and setting of steam boilers. I shall, however, endeavor to keep as close as I can to my subject, touching only such points on the care of boilers as may be in my opinion conducive to safety and economy.

We know from experience that all boilers are gradually weakened by the work of destructive agents upon them from the time they are put into operation until they are discarded and carted away to the scrap heap in some rolling mill yard.

The rapidity with which this deterioration takes place depends to a great extent on the following: 1st. The quality of material and workmanship; 2nd. The location of boiler setting; 3rd. Last, but not least, the amount of care bestowed upon it by the man who is placed in charge.

One of the worst enemies of a steam boiler, with which we have to contend, is external corrosion, and it is to a great extent caused by negligence. This form of corrosion is often caused by the guage cocks, man holes, flange joints, tube ends, rivetted seams, &c., being allowed to leak and drip down the front and shell of boilers day after day where (oft times) "out of sight, out of mind," the plate is eaten away in a surprisingly short space of time to such an extent as to become dangerous. I notice that it is a very common thing to find the heads of boilers in the vicinity of the hand holes eaten away from the above cause. How often do we hear a man make use of such an expression as this after making a hand hole joint and finding it leaks a little, "*Oh, it's good enough!*" Every engineer in this room will agree with me when I say that there is nothing good enough for a steam boiler in the way of care and attention, unless it be the very best which the engineer has in his power to give.

The old saying, "As a man sows so shall he reap," is never more applicable than to a boiler in regard to the result of good, bad or indifferent handling as the case may be. Just as soon as a leak is discovered around a boiler it should be attended to, as if not it only tends to make matters worse, as I have before stated by inducing corrosion, as hot water and coal soot combined are corrosive agents of great strength and it is surprising how soon they will eat away the sheet to one-half of its original thickness. As I stated above this is a very common occurrence around hand hole doors and the plate is often found eaten away to such an extent as to need patching. I can attribute such cases as this to nothing but carelessness, as it can always be prevented by a little care and pains in making a joint. I have yet to find the hand hole that I can't make tight.

My way of making a hand hole joint is as follows: Clean the plate and sheet well, then wind about three turns of cotton wick tightly round the plate, cut a gasket of ⅛" rubber to fit plate snugly, then on top of it smear well with black lead or plumbago and oil. I never use red or white lead around a boiler except for pipe threads, and even for that I believe plumbago is the best. By using the black lead and oil on the rubber it can be removed at any time, and the gasket will adhere to the plate, having a smooth face, and can often be used three or four times. I have often packed so-called "hard ones" in this manner and made them quite tight when other means have failed.

For man hole plates I always use ¼" asbestos board cut to fit the plate snugly, then soak it in water for an hour, put it on the plate smearing the side coming in contact with the boiler shell, well with black lead and oil. Then when breaking joint again it will only be necessary to pour some water over the asbestos to soften it and apply more black lead and oil, and it is ready for use again. I have made joint for a man-hole in this manner which has lasted four years and been broken every three months. I believe this to be the cheapest joint for a man-hole plate, taking everything into consideration. Asbestos is a good steam packing, but I would not advise its use on water joints, such as hand-holes, as the water will soak through it.

We now come to the internal corrosion, which is another form of wasting away, but it is not quite so rapid as external corrosion when left to take its own course. The action of internal corrosion may be classified under the following headings, viz: Chemical, Galvanic, and Mechanical. It is chemical when seen in the form of the rusting away of plates in a uniform manner. When galvanic, its presence is made known by the rivet and stay heads being eaten away, also by pitting taking place in the tubes and sheets. We also find the ends of gauge glasses eaten away thin in some boilers from the same cause. Galvanism is a species of electricity which is excited by establishing contact or communication between two metals through the medium of a liquid and it possesses energetic decomposing power. Mechanical action, such as grooving and buckling of plates, is caused principally by unequal expansion and contraction. If we look into this matter a little it will not be hard to understand the cause of buckling and grooving. Take for instance an internally fired boiler such as the Lancashire or Galloway, and it is very evident that the difference of expansion between the furnace flue and the shell must be considerable, owing to the high temperature of the fire, and as the flue cannot expand very much endways on account of the rigidity of the heads, it has to adapt itself under these conditions somewhat to the shape of a bow' and it is from these actions that the grooving occurs in the roots of angle irons that secure the flue to the heads in this class of boiler. Mechanical action like the above frets and irritates the iron or steel until the skin is broken. The fracture is also acted upon by any acids which may be present in the water until the groove or fracture extends in many cases clear through the sheet. This action of grooving is frequently found, as I said before, around the roots of angle irons and flange plates of Galloway and Lancashire boilers, but is not found so frequently in the horizontal tubular boiler as commonly used in this country. A short time ago the writer saw some furnace flue angle irons taken out of a large Galloway boiler which were grooved the whole circumference with the exception of a space about 2 inches long.

The practice of some engineers of opening the furnace doors of boilers to check the generation of steam instead of having and using dampers cannot be too severely condemned, as leaky seams, rivet cracks, and other evils must follow such a practice, to say nothing of boiler maker's repair bills, and yet it is daily persisted in by some men.

It should be the aim of every fireman and engineer to keep the temperature of the furnace as near one point as practicable, if they wish to have a boiler free from leaks and thus reduce the sudden expansion and contraction to a minimun. The man who throws on a heavy fire and lets it burn up and die down until there is barely enough incandescent fuel to ignite fresh coal, and charges up his furnace again with green coal is not doing his duty either to his boiler or his employer as such slovenly work cannot fail, in time, to produce bad results to the boiler, to say nothing of such a course being uneconomical in the generation of steam.

In regard to internal corrosion, where it is uniform and in the shape of rusting away of the plates, I believe the best thing is to get a sample of feed water analyzed and a compound prapared especially to counteract the action of the corrosive agent or agents in the water. Fortunately for us we are not troubled much in this part of Canada by this form of corrosion. For the second form of corrosion, which is galvanic, I know no remedy, except to watch boilers carefully and have them inspected regularily, so that all defects may be discovered and made good before they become actually dangerous. In the case of pitting, which occurs mostly in low pressure heating boilers where the condensation is returned continuously to the boiler, I would advise that a few pounds of sal. soda be put in the boiler during the winter, and when laying up the boiler for summer, after washing it out thoroughly with hose and making all joints good, put in 10 lbs. of sal. soda and get up 3 or 4 lbs. of steam on boiler alone, then let boiler cool off and when cool fill up with water to the stop valve on main steam pipe. The above treatment will arrest the action of pitting, and in a damp place where a boiler stands idle all summer, after smearing boiler all over with coarse oil fill up with water and put in ten pounds of sal. soda dissolved and let it remain until the fall or whenever it may be wanted. This treatment will keep the boiler free from external corrosion caused by a damp cellar.

To guard against grooving and buckling, I would say, have

* Paper read at the annual convention of the Canadian Association of Stationary Engineers, Hamilton, August 29th and 30th, 1892.

enough boilers to generate the necessary amount of steam without having to force your fires, the effect of which is to shorten the life of your boiler and this to at the expense of economy in fuel. It is a mistake to put in two boilers of 100 h. p. rated capacity to do 250 h. p. actual work. It would pay well in the long run to put in four boilers of 100 h. p. rated capacity and run with slower fires and be in a position to shut one down at any time for cleaning. There is no advantage in forcing a steam boiler, look at it from any point we may, but I am well aware that it is a very hard matter to get some steam users to regard it in this light as it seems to them always a matter of dollars and cents in the first cost.

I came across a case not long ago where a man boasted to me with apparent pride that the man-hole plate of his boiler had not been removed since the boiler was put in, which is some nine or ten years ago, and that he only took out the hand-holes and washed out once a year. When such men as this are allowed to control steam boilers, is there any need to wonder that week after week we read in our daily papers of boiler explosions and loss of valuable lives and property? Many people think boiler explosions are purely accidental and can't be avoided ; I maintain that this is a mistaken idea, and I feel sure that if all the details of these explosions were known the cause would in many cases be traced to ignorance and negligence of the common sense rules which should govern the operation of steam boilers.

From the reports of the different boiler inspection and insurance companies of this and other countries, also of districts where an Engineers License and Boiler Inspection Law are in force and faithfully carried out, it is fair to assume that these boilers which have exploded during the past year would not have done so had they been inspected.

No boiler of the horizontal tubular type should be allowed to run over a month, when generating steam for power, without washing out, and the man-hole should be removed at least every three months and the fireman go inside with scraping tools and dislodge all the scale and deposit he can, afterwards taking in the hose with him and washing off tubes and shell thoroughly. It is a good thing two or three days before washing out to pump into the boiler 10 or 12 lbs. of sal. soda, as this will soften the scale and make it much more easy to remove.

In case a boiler is badly scaled I have found the following a good course to pursue: when a boiler can be laid off for a few days, put in from 20 to 50 lbs. (according to state of boiler) of caustic soda and get up 60 lbs. pressure of steam, and keep it up for a day, then let steam down but keep enough fire going to keep boiler hot and water at 212° F. for a few days. Then let boiler cool down, let off water and wash with hose under good pressure, and repeat the dose if necessary. This treatment has been found to clean a boiler when everything else has failed. Some engineers are in the habit of blowing off a boiler under steam pressure and turning on the cold water to wash out while hot, as they claim by so doing it takes off the scale. That it does so is no doubt a fact, as the sudden contraction of the plates is so rapid that the scale is cracked and falls off. In following such a course a man may get off some of the scale, but the damage done to the boiler from such sudden contraction is such that it soon means a bill from the boiler shop for repairs.

The proper way to wash out a boiler is to let both boiler and brick-work cool down, if possible, then run off the water, and open up hand-holes, when the mud and sediment will be found in the bottom of shell and can be easily removed. After filling up the boiler with cold water put a slow fire under it and gradually warm it up. Forcing a heavy fire under a boiler full of cold water is as bad or worse than blowing off under pressure and washing out hot, and the engineer who boasts of having got up 20 lbs. of steam from water at 45 ° F. in 20 minutes, only shows his own ignorance.

Every man who has charge of steam boilers should take a pride in keeping them, and everything in connection with them, clean and in good order. He should be cool and collected in case of an accident, and not like a man I knew of a short time ago, who took a situation to run a small engine and boiler and when the second day, the guage glass broke, put for the street and could not be induced to go back until the engineer from the next door had been in and shut off the valves communicating with the boiler. Never allow any oil to enter your boiler. I am aware that many engineers believe that a little cylinder oil in a boiler is a preventative against scale, but be this as it may (and I am not prepared to contradict it), it is a well known fact to many engineers that very serious damage has been done to boilers by reason of oil mixing with the impurities held in the water and forming a kind of paste which in some cases has fallen to the bottom of boiler and remained there, and owing to the fact that this oily paste has kept the water from taking the heat from the plate, the result has been that the plate has been heated to such a temperature that the pressure has bulged the plate down, and in some cases a fracture has taken place. Some engineers will tell you they have allowed the oil from the condensation of exhaust steam to be returned to the boiler for years without any harm to the boiler, but I could tell you of places where it was only allowed to go in three months or so and the result was overheating of sheets, and when the sheets were cut out the oil and mud was found thick on the water side of sheet. The best cure for anything is prevention, and if the oil is being returned in condensation from your exhaust heating system to to your boiler, my advice is to take means to prevent it at once, or if you neglect to do so you may have trouble. It is a pleasure to go into boiler rooms where cleanliness is observed, not only on the brass mountings and fronts, but up over the tops of boilers, which in too many places serve as a lumber room for pipes, bricks, old bags and a large quantity of dust. A boiler should be kept as clean upon top as in front, and it is a very small matter to keep it so when once it has been put in that condition. The plea which is so often put forth by engineers as an excuse for a dirty, slovenly engine and boiler room, "*Oh, if it suits the boss it will suit me*," is about played out. The men who get on well are those who take an interest in all they do, are clean and tidy about their engine rooms, and put in their spare time reading and studying, in order that they may keep up to the times and be in a position to take advantage of a better position when it offers itself. It is this style of man who gets there every time.

This Association has been the means, both directly and indirectly, of bettering the positions of a good many engineers, and in so doing has been a benefit to quite a number of steam users, but I do not consider that the latter have given us that consideration and support which we were entitled to. Nevertheless we are gaining in this respect steadily, and shall continue to do so as long as our organization is based on a principle which recognizes the identity of interest between employer and employee, and the belief that true merit will bring its reward in the shape of good wages without the intervention of strikes and the misery which follows them, and which we in Canada are fortunately free from in their worst form.

Mr. President, officers and brethren, I thank you now for your kind attention to the reading of the paper. I only wish I had the ability to handle the subject better. I trust that in the future several papers will be read each year, on subjects interesting to us all as engineers, as such papers cannot fail to be instructive, and will tend to prove to our fellow citizens and employers especially that we are endeavoring to keep up with the procession and to advance the cause of steam engineering.

PERSONAL.

Miss Yule, daughter of Mr. John Yule, manager of the Guelph Electric Light Co., left home on the 24th of October to spend a year with friends in Scotland. Her companions in the office of the company presented her with a kindly worded address and a valuable field glass as a parting token of their esteem.

Invitations have been issued for the wedding on the 7th inst. of Miss Emily Selina Ryan, of Newport, R. I., and Mr. John Carroll, Secretary-Treasurer of the Eugene Phillips Electrical Works, Montreal, and 2nd Vice-President of the Canadian Electrical Association. The joyous event will take place at the residence of the bride's mother, 13 Bath Road, Newport. Taking it for granted that the bride is as charming as our fancy paints her, and knowing as we do the many excellent qualities of the groom, we extend to both our best wishes. Now that their days of "sparking" are over, may the future "current" of their lives flow smoothly and pleasantly on till the "circuit" of existence shall close.

The supreme court of Michigan has decided that a street car company which is not obliged by law to give transfer tickets, and which does not represent to the public that it will do so, may make its transfer tickets conditional upon being used within 15 minutes after being given.

THE TORONTO TECHNICAL SCHOOL.

Following is an abstract of the address delivered by Mr. John A. Duff, Principal of the Toronto Technical School at the opening of the second term on Oct. 3rd.:—

It has been announced that I am to speak to-night on "The Benefit of Technical Knowledge in Mechanical and Industrial Pursuits." It would probably be inferred that I would endeavor to ennumerate the advantages and advocate the claims of Technical Education in general, but I do not think that any one will be disappointed at hearing that such is not my intention, for I feel sure that everyone will be more interested in hearing what facilities for such education are provided by the Toronto Technical School, and by explaining the scope and bearing of the subjects taught I think I can more effectively than in any other way make clear to you the advantages to be derived therefrom.

The history of the Toronto Technical School is brief. In December of last year the City Council passed a by-law, appointing a Board of Management and giving them an appropriation of $6,000 and the free use of St. Lawrence Hall. The Board at once began the work of organization; teachers were appointed, and the courses of study decided upon, and St. Lawrence Hall having been found unsuitable, this building was secured and the necessary alterations made with such expedition, that by the first of February the work of the session was well commenced. The attendance from the first was large, and was well maintained throughout the term, and very satisfactory progress was made.

Such has been the past. There is every reason to hope that the coming year will be still more successful and that the Toronto Technical School will rapidly become a great power for the dissemination of scientific knowledge and habits of correct thought. With additional teaching power we have been able to make the course of study more comprehensive. Trigonometry will be taught twice a week instead of once, which was all the time we were able to devote to it last year, and, if necessary, the classes in Arithmetic and Measuration will be sub-divided. Arrangements have been made for three classes per week in Chemistry and Physics, which will enable us to provide a tolerably complete course on electricity—that mysterious power which seems destined to usher in a new era of civilization. There is thus provided for the current year the following distinct courses of study: Mathematics, including Arithmetic, Mensuration, Algebra, Euclid, Trigonometry; Practical Geometry, Descriptive Geometry, Mechanical and Architectural Drawing; Mechanics, including Statics, Kinematics and Dynamics; Chemistry and Physics, including Hydrostatics, Heat, Sound, Light and Electricity.

Each student is allowed to select his own studies subject only to the requirements of the time table. With only ten teaching hours in the week it is impossible to make provision for all the classes without having two different subjects occur at the same time, and thus to some exent the freedom of choice in the selection of studies is curtailed. The time table has, however, been carefully arranged, so that the least possible inconvenience will be felt from this source. For example, if a student has so far forgotten his Arithmetic that it would be necessary for him to take lessons in that subject, he would not be able, until he has become familiar with Arithmetical operations, to derive much benefit from the lessons in Mechanics. We have therefore put Arithmetic and Mechanics down for the same hour, and the students who find it necessary to review their Arithmetic, and who wish to study Mechanics, will find it not a hardship but very much to their advantage, to take Arithmetic during the present session and defer the Mechanics for another year. As the success of the student and therefore of the school depends largely on the proper selection of the course of study, let me briefly describe the different subjects taught, and incidentally mention some of the advantages derived from each.

Let us begin with Mathematics, the interpreter and berald of scientific knowledge, and without which little real progress can be made. Mathematics is one of the most potent instruments of scientific investigation, besides being the only foundation upon which exact scientific knowledge can be built. In Science and Engineering, theories are of little value unless they are exact and definite, and we cannot have this exactness without Mathematics. A knowledge of Mathematics is not necessary in order to understand the general laws of nature, but it *is* necessary in order to state those laws with exactness or make any practical application of them. Anyone can understand that water will flow through pipes, but no one can calculate the quantity which will flow through a given pipe in a given time without a knowledge of Mathematics. I do not mean to say that Mathematics must be pursued to its highest developments, but it *is* necessary to have at least a good working knowledge of Arithmetic, Algebra and Geometry.

The course on Arithmetic—the corner stone of Mathematics—will comprise instruction in numeration and notation, the operations of addition, subtraction, multiplication and division, the use of fractions and decimals, ratio and proportion, the method of extracting square root and the theory of logarithms—in short a complete course in Pure Arithmetic, including all the arithmetical operations which are used in the other branches of Mathematics and Science, but excluding Commercial Arithmetic, which is the application of the forgoing rules to the computation of interest, discount, stocks, annuities, &c., and which finds its proper place in the curriculum of a Business College.

Along with Arithmetic are taught the rules of Mensuration, by means of which the areas of surfaces and the volumes of solids may be calculated and compared. A knowledge of these rules may be required by any man at any time or place.

In Algebra the work will be the same as that which is ordinarily taught in the High Schools of Ontario, which is all that is usually required in pure or applied science. I will not occupy your time with a more particular ennumeration, but I wish to impress upon all intending students the vital importance of Algebra in chemistry and physics. In these sciences formulae occur which can only be properly expressed by algebraic symbols, and the only practical method of solving problems or determining an unknown quantity, is by means of algebraic equations. But if Algebra is of so great importance in Chemistry and Physics, it is absolutely indispensable to the proper study of Natural Philosophy or Mechanics. Very few calculations involving force or motion can be made without its aid, and without Algebra a knowledge of Mechanics must always prove to be incomplete and unproductive. What has been said of Algebra is true to almost as great a degree of Trigonometry and Euclid's elements of Geometry. Euclid has the further advantage of being one of the most perfect systems of logic that has ever been constructed, and no one can master Euclid without becoming a logician.

Let me here remark that the aim of higher education ought not to be so much to fill the student with dry facts, as to teach him how to use what knowledge he already possesses—in other words to teach him how to think properlyand to act accordingly. And one of the greatest works that a Technical School can do is to teach mechanics the *art of thinking*. To do this there is no study so efficacious as Mathematics, for there is no other branch of knowledge so exact and definite, and there is no other in which the reason alone is employed.

In Chemistry, it is proposed to teach the mode of occurrence, the nature, and methods of preparation of the different elements and compounds which are of importance in everyday life, special attention being given to those substances and processes which are of technical value, such as electrolysis, coal, and the manufacture of coal gas, iron and steel, mortars and cements.

Lying in the border land between Chemistry and Physics, is the study of the constitution and properties of matter:—a few lectures will be devoted to his very interesting subject.

Under Hydrostatics will be taught the general character and properties of liquids, and the theory of the common hydrostatic and hydraulic instruments, such as the hydrostatic balance, hydraulic press, spirit level, hydrometers, electrometers, etc. Along with hydrostatics, though scarcely belonging to it, come the physical properties of gases and the atmosphere, the theory of the barometers, pumps, balloons and siphons.

The course on Heat will embrace the nature, sources, transmission and general effects of heat, the theory and construction of thermometers, the determination of the melting and boiling points, freezing mixtures, distillation and evaporation, and the theory of steam engines.

Lectures will be given on the elementary theory of Sound and Light in, which the theory and construction of optical and musical instruments will be described.

Electricity will be taught in two divisions. The relation of Chemistry to electricity, and the theory and construction of electric batteries, will be described in connection with the course on Chemistry. In connection with Physics, there will be a course on magnetism and current electricity, the theory and construction of the dynamo, telephone and telegraph, and the applications of electricity in daily life.

In Chemistry and Physics the lectures will be illustrated by experiment as far as our apparatus will permit. We hope that very soon, though perhaps not during the present year, there will be a laboratory in connection with the school, in which practical work in Chemistry and Physics may be done by advanced students. The advantages to be derived therefrom must be apparent to all, and let us therefore hope that it will soon be an accomplished fact. There will be a course on Practical Geometry, which is intended to give facility in the use of drawing instruments and the construction of geometrical figures. It will be found very useful as an introduction to the course on Descriptive Geometry or the theory of projection. That on Descriptive Geometry will comprise the representation of objects by means of a plan and elevation, and problems leading up to and solved thereby, such as the determination of the form of the intersection of two cylinders or cylinder and a cone, together with instruction in oblique and perspective projection. This course, which involves the theory of drafting, is of great utility not only to those who are trying to perfect themselves as mechanical or architectural draftsmen, but to sheet metal workers and any whose occupation requires them to have some knowledge of working drawings, as pattern makers, boiler makers, machinists, etc. In connection with the Descriptive Geometry, practical instruction will be given in the drafting room in instrumental drawing, lettering, etc., for which purpose copies and models of machine and building construction will be available. This instruction will be given to the students individually and for this purpose the drafting room will be open, and an instructor will be present during every teaching hour of the school. A student who takes this course of practical work in the drafting room should be able by the end of the year to read a a drawing without any difficulty, and also to make a fairly good original drawing, and at the end of two years he should be a fairly good draftsman.

The course on Mechanics will embrace the theory of vectors, the representation, measurements and laws of forces and motions, the theory of equilibrium, theory of the lever, pulley, and other simple mechanical powers, the calculation of stresses, theory of the simple beam, the transmission of force and motion, friction, work, energy, power, the efficiency of machines and the elements of machine design. I hope that this brief outline of the courses of instruction will enable intending students to choose wisely the subjects which they most require. But should there be any who are still unable to make a choice, the teachers will be glad to give

whatever further information may be required. Most students will find that they will be unable to pursue more than two or three courses of study during the year. I would advise those who thus find it necessary to defer some of their studies, to take their Mathematics first, for the reason which I have already given, that a knowledge of Mathematics is essential to a proper study of the other subjects. From what I have said or from a reference to the prospectus it might be inferred that we expected to complete all our courses of study in one year, but such is not the case. In Algebra, Euclid, Descriptive Geometry, and perhaps some of the other subjects, two years will be required to complete the course, and it is expected that the advanced classes in these subjects will be formed next October. And, without interfering with the perfect freedom of choice now enjoyed by students wishing to pursue a special line of study, it is hoped that we will then be able to announce the programme for a regular course embracing two or three years. The experience of the past winter has convinced me that in Toronto the demand for technical education is urgent, but the citizens may rest assured that on the part of the Board of Management or the teaching staff of the Technical School no effort will be wanting to supply that demand.

SPARKS.

Six new vestibule cars and a sweeper are in course of construction for the Ottawa Street Railway Company.

The Ottawa electric street railway carried without accident during the recent exhibition in that city, 138,000 passengers.

It is proposed to increase the capital stock of the National Electric Tramway and Lighting Co., of Victoria, B. C., to $1,000,000.

A conductor named Snyder on one of the Hamilton electric street cars, was crushed between two cars on October 9th and fatally injured.

The Nanaimo Electric Light Works were advertised to be sold by auction on the 29th of October. The result of the sale has not yet been learned.

The wire, lamp and fixtures department of the Peterboro Electric Light Co. has been purchased by Mr. J. H. Greer, an experienced electrician.

The establishment in connection with the Ottawa University of a department for the teaching of electricity, is understood to be in contemplation.

The town of New Glasgow, N. S., has been asked to approve of a route for the electric street railway which the New Glasgow Electric Co. propose to construct.

The town council of Cote St. Antoine, has decided to grant a franchise for the construction of an electric street railway, to the Montreal Street Railway Company.

The Montreal Incandescent Light Co. are seeking incorporation for the purpose of manufacturing apparatus for electrical purposes. The capital stock is placed at $1,000,000.

The town of Chatham has granted the franchise to the local electric company, for the construction of an electric railway, and the right to furnish light and motive power to factories.

The vacancy on the board of directors of the Dominion Telegraph Co., caused by the death of Mr. Alex. T. Fulton, of Toronto, has been filled by the election of Mr. Hector McKenzie, of Montreal.

The St. Catharines electric street railway, which has been in liquidation for some time, was sold by public auction on October 22nd. Mr. George Dawson, of St Catharines, was the purchaser, the price paid being $20,000.

The telephone service in Toronto has been seriously affected by the heavy currents passing through the trolley wires. The difficulty will be aggravated when the electric cars are put in operation on Yonge street and the belt line. Meanwhile, the Bell Telephone Co. are pushing forward as rapidly as possible the work of putting their wires underground.

The generators that George Westinghouse is building to furnish electricity for the 93,000 incandescent lamps at the World's Fair are to be the largest in the world. One of them will operate 20,000 lamps. "The ordinary generator supplies but 1,200 lamps," Mr. Westinghouse said, "and most of them less. Our largest generator will supply 20,000 lamps, and most of the others will be of 10,000 lamp capacity each."

A file with which a young man named Black was engaged in filing a switch at the Toronto Street Railway power house, recently, came in contact with the positive and negative wires, with the result that a portion of the file was melted, and the young man severely injured. Had it not been for the fact that the file received a considerable portion of the charge, Black would not unlikely have been killed; as it was, he lost his eyesight for some days.

The city of Brantford, Ont., voted recently on the question whether it should operate its own lighting plants and the local system. The result of the vote was against the project. Such ownership would be an interesting experiment to watch, could it have been undertaken, because of its novelty, but the vote showed that the ratepayers of the city were not seeking any novelty. Municipal ownership of electric plants does not seem to be very popular.—*Electrical Industries.*

The Toronto Street Railway Co. are turning the building formerly used as stables, into a power house. There will be installed five compound engines, four of 550 horse power, and one of 325 horse power. These engines are to be placed in position in a few days. A chimney stack 120 feet high, the tallest in the city, is in course of erection. The power house is expected to be in operation by the first of the new year. The total cost of the plant will be about a quarter of million dollars.

PRICES FOR ELECTRIC LIGHTING IN BRANTFORD.

BRANTFORD, Oct. 29th, 1892.

Editor ELECTRICAL NEWS.

SIR,—Our attention has been called to a short editorial which appeared in your issue of this month, which doubtless refers to us. After a careful perusal of same, we are forced to the conclusion that some one with very little regard for truth has imposed on you.

We have had the contract for the public lighting of the streets of Brantford by electricity for five years, and although the penalties provided for in the agreement were as binding and harsh as they possibly could be, our company never once during the whole of that time received any notice from the city authorities that our lighting of the city was inferior, as alleged by you. And it is safe to say that they would have a better knowledge of the subject than either your good selves or your informants.

Tenders were called for in August last for another five years. Competition was keen. The Brantford Street Railway offered to light the city with sixty (60) lights more or less for twenty-six (26) cents per night, all night and every night; our tender was twenty-three and a half (23½) cents. Although the lowest, the majority of the City Council, for reasons that are familiar to us, refused to accept our or any of the other tenders, and submitted a by-law to the ratepayers asking authority to issue debentures to enable the City Council to go into the public lighting business. Our company and their friends fought the by-law and defeated it in every polling subdivision of the city. Every vote against the by-law was in favor of our company, and the action of the people is a rebuttal of your statement. The City Council then offered us the lighting for one year at 23½ cents per night, moonlight schedule, deducting from the 23½ cents per night every moonlight night, and this for only one year instead of five. The contract is now all night and every night. We had to accept these terms or be driven out of the public lighting business, and now you are disposed to allege that under the first contract we furnished inferior service, and on this account were driven into the position of accepting the present low figure. If we are to blame, with ample water power at our command, what have you to say about the offer of the Brantford Street Railway, owned now by the Canadian General Electric Co., of your city, who have to use steam power, and were very anxious to get the contract against a local company, at 26 cents?

Yours truly,

BRANTFORD ELECTRIC LIGHTING CO.

[As the above letter reached us only a few hours before going to press, comment thereon in this issue becomes impossible. We may deem it advisable to refer to the subject in our December number.—EDITOR ELEC. NEWS.]

PUBLICATIONS.

The Arena for November closes its sixth volume with a table of contents at once strong, varied and of general interest. This Review continues to grow in favor without lessening in a jot its bold assault on conventional shams and wrongs of the age. Nor does it show any sign of being less hospitable to new progressive and reformative thought. It is conspicuously fair and unquestionably the boldest Review of our time.

TRADE NOTES.

The Ball Electric Light Company report as recent sales, 750 light alternating dynamo and installation, two 50 light 4 ampere arc dynamos to Oshawa Electric Light Co., Limited; also 500 light alternating current dynamo and installation to Oakville Electric Light Co.; one 25 light 4 ampere arc dynamo to Wm. Stuckey, Grand Valley, Ont. Quite a number of the Ball Co.'s stationary motors have been sold this month in Toronto, London and Ottawa.

The first of a series of meetings of officers and employees of the Bell Telephone Co., in Montreal, to discuss matters affecting the perfect working of the system, was held recently in the ante-room of the main exchange. Mr. Miller, superintendent of the inspectors' department, presided. Mr. C. E. Getz, manager of the exchange, also took part in the proceedings. The means of overcoming the difficulties caused by induction from street railway currents were considered.

Cutting rubber for making gaskets or other purposes is always a difficult task when a dry knife is used, no matter how sharp the blade may be. It is said that if the blade be wet with water contatning potash the cutting may be easily done with the exertion of much less strength. A thin blade, such as that of a case knife, is much better than a thicker blade, like that of a jack knife, and an easy way to sharpen a knife for cutting rubber is on a round or half-round file, which gives a saw tooth edge that is very effective in cutting rubber, leather or other tenacious material.

CANADIAN ELECTRICAL NEWS AND STEAM ENGINEERING JOURNAL

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EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

THE "CANADIAN ELECTRICAL NEWS" HAS BEEN APPOINTED THE OFFICIAL PAPER OF THE CANADIAN ELECTRICAL ASSOCIATION.

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ON October 15th, two boilers in a rolling mill at Portsmouth, Ohio, exploded, wrecking the mill and injuring nine men. Four hundred men were at work in the mills at the time, and it is a wonder that not more were injured.

WE understand that the Bill which is proposed to be introduced in the Dominion Parliament at its next session, relating to the electical interests, will cover the testing of electric light meters, an insulation test of the consumers' wires and regulations in regard to a constant supply of energy at the consumers' terminals.

A TELEPHONE circuit one thousand miles long has just been completed, establishing connection between New York and Chicago. The line has been tested and is said to work satisfactorily. There was used in its construction 50,000 poles,—fifty poles to the mile—on which are strung two lines of No. 8 copper wire.

BOILERS used for heating purposes are very liable to suffer from internal corrosion of the tubes. The use of the same water returning from the heating coils has much to do with it. The remedy is to change the water during the winter by occasionally blowing some off, and filling up with fresh water. A boiler should not be allowed to stand idle with the same water in it that has been used in making steam. If the water is to be idle, it is better to empty the boiler and fill up with fresh water.

WE referred recently to the fact that the advocates of the storage battery system of street car propulsion were endeavoring to create opposition to the trolley system in Montreal, in the same manner as was done in Toronto, and that the president of the Street Railway Company had offered to stake the sum of $5,000 on the result of the finding of an impartial committee of experts, if the storage battery advocates would deposit a similar amount. This offer does not appear to have met with any response, but to satisfy the citizens, the City Engineer was commissioned to visit Boston, and report on the merits of the storage battery system. In his report he publicly states his opinion that the storage battery as applied to the operation of street railways, does not fulfil the requirements. He believes that the trolley has come to stay, and that it will be found to work well even under the severe conditions imposed by winter in the Province of Quebec.

THE high rate of speed at which the electric cars have been run in Hamilton, has been the subject of remark by visitors to that city. Whether from this cause or otherwise, a number of accidents more or less serious have taken place. In the case of the last of these accidents, the coroner's jury, while attaching no blame to the mortorman or conductor of the car, recommended that the City Council should pass a by-law, to regulate the speed of cars to six miles per hour. In Toronto and elsewhere a similar suggestion has been made. It is one which in some respects, is open to objection. It might be made to apply to the smaller cities, where only short distances have to be covered, and to the central parts of large cities. In the case of the latter, it should not be forgotten, that one of the chief advantages of the electric system over horse cars, is its ability to carry passengers to their destination in less time, and if an arbitrary rule is to be applied which will regulate the speed of electric cars to that of horse cars, this great advantage of the electric system will prove valueless.

WE referred to the fact recently that the experience of the town of Toronto Junction with the operation of its own electric lighting plant, had proved to be unsatisfactory, the cost having been far in excess of what it would have been had the light been supplied under contract. The Town Council appears to have carried the experiment as far as is considered desirable, with the result that negotiations are now in progress for disposing of the plant to a private company. It is understood that an agreement for the purchase of the plant by the local street railway company, at the price of $18,000, under a 19 years' franchise had been almost concluded, when some additional privileges, such as the free use of water for condensing purposes and exemption from taxes, were demanded, which has been the

means of reopening consideration of the question. It is rumored that a Toronto electric light comapny is also making an offer for the plant and franchise. The experience of Toronto Junction should serve as a warning to other municipalities who are thinking of attempting to do their own lighting,

CORROSION of metal is sure to take place if small leaks in steam boilers are allowed to go on. A large leak disturbs the supply of steam and alarms the man in charge, but little ones are often allowed to exist till the strength of the metal is diminished and explosion follows. Look out for the little leaks and have them stopped. The brickwork was removed from around a boiler in this city a few weeks ago, and on clearing away the dirt, about a dozen places were seen where the plates were eaten into small holes nearly through the entire thickness. The brick setting was not renewed around the boiler.

IN a recent issue, mention was made of the fact that the electric street railway in process of construction in the city of Montreal, would have to encounter severe difficulties in winter, owing to the large amount of snow and severity of frost which are the accompaniments of winter in that locality. This difficulty has evidently received careful consideration on the part of the management of the road, and the plan and means of overcoming it have just been decided upon. Mr. Everett, the managing director, states that it is the company's intention to begin at once the construction of one hundred sleds, which are to be used for the removal of the snow. There have also been purchased three powerful sweepers and a scraper. As soon as the snow begins to fall the company will at once put to work one thousand men to shovel it into the sleighs. Mr. Everett is of opinion that the company will succeed in keeping the streets sufficiently clear of snow and ice to enable them to continue traffic uninterruptedly throughout the winter. The attempt to accomplish this will be watched with no little interest by the citizens of Montreal, as well as those of other cities similarly circumstanced.

SEVERAL boiler explosions, attended with disastrous results to property and human life, have recently taken place in various parts of Canada. The most recent accident of this nature occurred a few days ago in the basement of one of the large business buildings in Hamilton. One of the large boilers used for heating the building exploded, wrecking a second boiler and setting fire to the premises. The fire department fortunately succeeded in putting the fire out. The boiler must have exploded under a very low pressure of steam, otherwise the results would certainly have been more serious. Occurrences of this kind emphasize the need for a higher standard of proficiency on the part of persons entrusted with the care of steam plants. Steam boilers in the hands of incompetent persons are almost as dangerous in the basements of buildings as a package of dynamite. The law should require persons who aspire to take charge of steam boilers to show by examination that they possess the knowledge which would qualify them for the position, and a penalty should be imposed on persons assuming the duties of such a position without having undergone examination. Unless some provision is made which will insure competency, we may expect to hear of disasters even greater than those which have already occurred.

ON the 4th of October, the United States Court of Appeals gave final decision in the case brought to establish Mr. Edison's claim to be considered the original inventor of the incandescent lamp. The case has been before the courts since 1885. The decision is favorable to the Edison claim, and will prevent the manufacture of incandescent lamps, except by arrangement with the General Electric Co., who are now the owners of the Edison patents. This decision will have an important bearing on the interests of those who have entered the business of manufacturing incandescent lamps, but viewed from their standpoint, will be much less serious than it would have been if the decision had been rendered shortly after the case was commenced, owing to the fact that the Edison patents have now only about three or four years to run. The General Electric Co., recognizing no doubt that it would neither be possible nor profitable for them to attempt to do all the manufacturing of incandescent lamps, have expressed their intention of allowing manufacturers to continue business on payment of a fair royalty. There is no doubt that another effect of the decision will be to stimulate inventors to produce lamps which cannot be held to be infringement, of the Edison patents; indeed one of the leading competitors of the General Electric Co., the Westinghouse Co., of Pittsburgh, has already announced that it has succeeded in perfecting an incandescent lamp, which differs entirely in construction from those heretofore manufactured. Thus it would appear that the ultimate result of the decision just given by the courts, is likely to be advantageous to the manufacturers and users of incandescent lamps. In the meantime, the General Electric Co. will profit considerably by the monopoly granted them.

THE last annual meeting of the Canadian Association of Stationary Engineers, was the most interesting that has yet been held, and seems to have resulted in infusing new life into the organization. For the first time papers were read on engineering topics, followed by considerable discussion. This is a step in the right direction, and is following out the professed object of the Association, which seeks to be regarded as an educational factor. We observe that the relation of engineers in future to the electrical industries, came up for consideration. We have more than once pointed out that the care and operation of electric apparatus, in perhaps the majority of instances, will in future devolve upon engineers, that this is the time when engineers should be fitting themselves for the new duties which ere long they will be called upon to discharge, and that those who neglect to do so, will be relegated to inferior positions. The Association is no doubt working on proper lines in keeping aloof from trades unionism, and instead of demanding that its members, irrespective of qualification, should be paid a certain standard of wages, leaving the matter of salary to be settled between employee and employer, and devoting its attention to raising the standard of qualification of its members, so as thereby to enable them to command higher wages. The fruits of this policy are already beginning to appear. In numerous instances, those who have availed themselves of the means of improvement supplied by the meetings of the local associations, have been enabled to improve their positions. The fact of an engineer belonging to an association which is thus seeking to educate its members, is not likely to remain unknown to the owners of steam plants in the locality, and when a vacancy requires to be filled, they will naturally seek to fill it from the the ranks of such men. We think it would increase the interest in the Association if the meetings could be held semi-annually instead of annually.

WE note with a sense of gratification that there are several electric lighting companies who are making use of ⅝ carbon and a single lamp for all night lighting. As this is decidedly a step in the right direction we would be pleased to see the system more universally used. True the carbon must be of at least fourteen hours duration to last through the longest night; but as this is a matter that the manufacturers of carbons have accomplished, there need exist no fear of being unable to procure such a carbon. It is of great importance to those who may contemplate putting in an all night lighting plant to use the single lamp and ⅝ carbon, for by its use the cost of operation can be considerably lessened as compared with double lamps burning with 7/16 carbons. In the latter, three carbons are required for a 14 hours run, while in the former, but one and a half are necessary. Again, it is imperative that the double lamps be patrolled all night (if it is desired to give first class service) to keep them lighted, whereas with single lamps and the large carbons this is hardly required, at least not to such an extent. It is a well known fact that fully three quarters of the "outs" in 7/16 carbons are caused by "passed carbons," or in other words by carbons burning to a point and a heavy feed causing them to pass by one another and frequently lock, requiring the patrolman to set them back in their place before a light is again produced. This is not the case with ⅝ carbons. One reason is that they do not burn to a long point, and a flash on the dynamo or a heavy feed can only bring them down until they touch—they cannot pass by and consequently cannot lock, and the light cannot go out from these causes. We know of cases in which "carbon passes" on the ⅝ lamp were

never known to occur, but with a 7/16 it would be a rare thing to find one lamp of a large number that had not this cause for being out recorded against it on more occasions than one, particularly if, as frequently happens, the carbons are slightly crooked. All things considered we feel we are but echoing the sentiments of the present users of ½ carbons when we repeat that in an all night lighting plant there is an advantage in their use.

In the Annual Report of the Chief of the Bureau of Steam Engineering of the United States Navy for last year, attention is called to the fact that from nearly every war vessel in service in the navy, reports had come of the inefficiency of the firemen, and of the insufficient number employed. The Chief points out that no matter how efficient the vessel and the equipment may be in every other department, failure in the boiler room spoils the whole. If during an action, when the fullest power of the machinery is required, unskilfulness on the part of the fireman should let the fires become dull or choked with ashes and clinkers, all hope of success would be gone. The report urges upon the Government the necessity of attempting to remedy this evil and to encourage the firemen in becoming skilled and expert in their duties. In all factories and establishments where steam is used there should be more attention given to this very important subject. In these days of competition profits can be made by skill and care in saving. Begin here, not as is too often done by employing the man who is willing to work for the lowest wages, but the man who can earn good wages by skill in the use of the coal shovel. A few years ago a certain flour mill in Canada was closed. The engineer was ordered to dismiss his staff of firemen. In about three months the mill was again started, but the firemen had gone elsewhere looking for work, and the old hands could not be found. With the same engineer and same machinery, but with new firemen, twelve tons of coal per day were required to do the work formerly done with nine tons. Here a change of firemen increased the fuel bill by 33⅓ per cent.

A case has come under our observation quite recently in which an existing electric light company was about to purchase a power generator for the supply of power to numerous small manufacturers and in which there existed the doubt as to whether it should be of 250 or 500 volts E. M. F. Eventually the 250 volt generator was given the benefit of the doubt. It may be pointed out to those similarly situated, that for many reasons, the 250 volt machine is undoubtedly the proper one to install. The principal reason is that it is absolutely safe to handle a current of this voltage. As the current is required to be carried into buildings and rooms in which there are quite a number of employees, this safety in handling becomes most imperative, for while there may be but one person whose duty it will be to handle and take care of the motor, there will likely be some inquisitive young person about the place who when opportunity offers will try his hand at it, and ten chances to one receive a shock, if it is possible to do so, before he gets through. If a low tension current is used it can do no greater harm than frighten, whereas if it were of 500 volts potential and contact were made with it for any length of time, it might not only cause a severe shaking up, but serious results would in all probability follow. True the cost of constructing the line will be much greater if 250 volts are used than it would be with 500 volts. Another point to consider is the lesser liability to short circuiting of the lines from any cause, for with the 250 volt circuit there will only be one half the risk of serious results following such short circuit; an arc of any length cannot be maintained; whereas with 500 volts it is quite easy to produce and keep going such an arc as would cause damage to the machine or some of its parts, or set fire to the building if not checked promptly. We are of the opinion therefore that the 250 volt circuit possesses an element of safety quite superior to that of the 500 volt, and is the only one that should be used for supply of small motors that are liable to be used in all manner of places and under all sorts of conditions. We cannot condemn too strongly the practice of connecting such motors on a grounded street railway circuit, as is done in some places. With 500 volts and a grounded circuit, it becomes absolutely dangerous, and should not be handled by other than a practical man at any time, much less should it be placed in a position to be handled by those who perhaps have not the faintest conception of the danger lurking therein. It is not the purpose of this article to make it appear that a 500 volt circuit is what is recognized as a dangerous one, for such is not the case, but we feel that we are not over-stepping the bounds when we again repeat that contact with a grounded 500 circuit is dangerous, particularly if such contact is made for any length of time.

CENTRAL STATIONS OPERATED BY WATER POWER.

Mr. George A. Redman writes on the above subject in the columns of *Practical Electricity* as follows :

The adaptation of water power for electrical purposes has grown very rapidly within the past few years : there are several causes operating to enhance the value of water power, none more so than that of electricity.

Streams that have had no pecuniary value heretofore are now being utilized for the purpose of running electrical machinery ; yet at the same time the supply of water is diminishing, caused by the destruction of forests, and water right owners in various parts of the country are devising means of storing water during the rainy seasons to furnish a supply during the dry season ; also storing it in the daytime for night use. One large water right owner in Western New York, during the months of July and August, places flash boards two and one-half feet high on top of his dam, at an expense of $100, and stores up for night use the water which is not necessary for him to use in the daytime, thereby saving in the two months a coal bill of $2,100.

The Johnstown, N. Y., Electric Light Company have improved their water power at the Cuyadota Falls by erecting a dam 34 feet high on top of the falls, giving them a total head of 75 feet and nearly doubling the amount of power.

A survey of the upper Genesee River, between Mount Morris, N. Y., and the celebrated Portage Falls, has been made during the past year, for the purpose of establishing a reservoir that will furnish the city of Rochester 30,000-h.p. more daily during the entire year, than they have at present.

The earliest forms of water wheels were the paddle and flatter wheels, that only utilized the impulsive action of the water ; these being followed by simpler wheels of the reaction type, and others.

We now have the improved forms of the Leffel, Victor, Lesner, Success, and many others. There is a demand for the best and most economical turbine that can be manufactured.

Turbines should be built to secure the delivery of the water upon the turbine without checking the velocity of the water more than one-third, and to permit the free discharge of same after passing through the turbine, and to work with as good efficiency under part gate as under full gate, and to be made of the best phosphor bronze, to stand the wear and tear under high heads.

It is essential in locating central stations to be run by water power, to locate them where there is no great danger of a flood, or so protected by a breakwater as to make it perfectly safe, and also to avoid trouble with backwater upon the turbines. Where a station is situated on the bank of a river, it is best to take the water from the river by means of a raceway, with the headgates parallel with the flow of the water ; and at times of a freshet or running of anchor ice, it will more than pay any expense incurred by so doing. The raceway should be of a sufficient depth and width to permit the water to flow not more than 90 feet per minute, and a waste gate should be placed in the side or end of the race to use in case of emergency ; and when cleaning out the raceway a rack should be built across the race to prevent driftwood and other rubbish from passing into the turbines. For that purpose I recommend a rack built of iron slats two inches wide, one-eighth of an inch thick, and placed five-eighths of an inch apart on seven-eights inch iron rods, at an angle of 45 degrees. Particular attention should be taken to keep the rack clean by raking. A trough or platform should be placed over and immediately back of the rack to rake the rubbish and anchor ice into, and so arranged that the current of water from the race will pass through the trough and carry off all of the rubbish, etc. For any station that is using 100 h.p., or over, it will be a great saving in labor to them and pay well for the extra expense. For winter service a boom should be placed in front of the headgates, and the current will carry off a large portion of the anchor ice and other floating objects.

The headgates should be built to work with a rack and pinion;

also a roller should be placed back of each gate stem to facilitate the handling of the gate. The gates should have a protection built over them, to protect the gearing from the storm. In a cold climate, where the gates are apt to be frozen in, salt is essential in freeing them from ice. All headgates and timbers should be of the best quality of oak, and should be well bolted, and not less than two gates to one raceway. The tail race should have no less than two or three feet of dead water when the wheels are not in motion. Where the tail race runs under the station, cement floors should be laid, to prevent moisture in the station ; a floor of that material will soon pay for itself. Vertical turbines should be placed so that the steps are covered with water at all times. In adapting turbines to very high heads, or to conform to location, it becomes necessary to set the turbines above tail water, and conduct the water away from the turbines, through a draft tube.

THE SUPPLY OF CURRENT BY METER.

By T. P. Wilmshust.

THE method of charging for current adopted by the Yorkshire House-to-House Company, as published in *The Electrician* of the 30th ult., raises a question of some importance. A large number of supply companies have adopted the plan of allowing sliding scales of discounts to consumers, and of those who have no such published tables the majority find it expedient to make to their larger customers a substantial reduction of price, based on the quantity of current used.

The system in vogue is to allow a rebate to a consumer after a certain number of units have passed through his meter, irrespective of the number of lights that consumer may have. This, though undoubtedly the simplest method, is by no means an equitable one. Take the following instance. A customer, A, has 100 lamps which he uses an average of one hour per day throughout the year ; B has 10 lights, and uses them 10 hours per day throughout the year. The number of units consumed by each is the same, and hence each receives the same rebate. B, however, is a far better customer to the supply company, for he helps to equalize their load curve, and only requires the use of one-tenth of the generating plant that A does.

To obtain a more even distribution of this load curve throughout the 24 hours is the fervent wish of central station officials. It was predicted that the more extended use of motors would bring about this happy result ; but, unfortunately, it is found in practice that the hours of motor load overlap the hours of lighting load. One company, I believe, actually proposes to influence the lower parts of the curve by flooding the market with such apparatus as electric griddles, electric curling-tongs, and the like.

The simplest way out of this uneconomical state of affairs is, in my opinion, the application of an equitable system of rebates, which shall operate not simply on the numbers of units consumed per annum, but on the number of units consumed *per lamp* per annum. This will place the consumer with a small installation (but who wishes to use his light freely) on an equal footing with the consumer with a larger installation. Bearing these points in mind, the following table has been worked out for use at the Exeter supply station :—

Cost to a consumer of a 30-watt lamp in use for 365 days for the hours named in first column, at a sliding scale charge of —

7½d. per unit up to 12 units, 6½d. about 12 and not exceeding 16, 5½d. above 16 and not exceeding 20, and 4½d. above 20.

Hours of burning each day.	Units used per annum per 30-watt lamp.	No. of units at 7½d.	6½d.	5½d.	4½d.	Annual cost under sliding scale. £ s. d.	Average price paid per unit.	Price if at 7½d. £ s. d.
1	10.95	10.95	...	...	...	0 6 10½	7½d.	0 6 10½
2	21.9	12	4	4	1.9	0 12 3	6¾d.	0 13 9
3	32.85	12	4	4	12.85	0 16 4½	6d.	1 0 7½
4	43.8	12	4	4	23.8	1 0 6	5½d.	1 7 6
5	54.75	12	4	4	34.75	1 4 6	5¼d.	1 14 4
6	65.7	12	4	4	45.7	1 8 7	5.2	2 1 0
7	76 65	12	4	4	56.65	1 12 8	5.1	2 7 9½
8	87.64	12	4	4	67.6	1 16 10	5.05	2 14 9½

—*The Electrician.*

One of the most interesting features at the recent exhibition in Ottawa was the heating apparatus invented by Mr. Ahearn. The visitors were enabled to witness the baking of bread and the heating of buildings by means of the electric current. The tea and coffee supplied from the lunch rooms were also heated by the same means.

BOGUS BOILER INSPECTORS.

TORONTO, Sept. 21st, 1892.

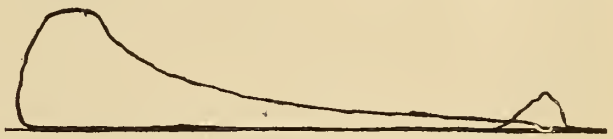
Editor Electrical News.

DEAR SIR,—In a city not 100 miles from Toronto there is a flourishing manufacturing concern, at the head of which is a man who is very wise in his own estimation. A few weeks ago it was decided to shut down this establishment in order to put in new machinery. The manager decided that this would be a good chance to have the boilers inspected, and, with this end in view tried to make arrangements with a boiler inspector to make an inspection of his boilers. For some reason best known to themselves, the proprietor could not induce the inspector to make the examination, and he at once commenced to look around for someone else. He was not forced to look long ; a man came along one day who claimed to have the necessary ability and experience to examine a boiler in the most scientific manner. He was at once engaged for the job, and was to give a written report as to the condition of the boilers.

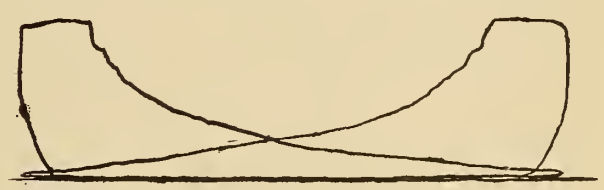
The engineer had everything in readiness for the "Inspector," who turned up on time, and after much talk about what he knew of steam boilers, commenced operations. He went in at the manhole of one boiler, and, in a few moments came out and announced that he had found a hole in the boiler, and that the brickwork along the side with the hole in it must be taken down to enable him to examine the hole externally. The brickwork was taken down, and the hole, which turned out to be a one inch plug, was examined, to the evident disgust of the "Inspector" and owner. The side of the boiler had been tapped to attach a pipe for some purpose. The "Inspector" had seen the hollow spot in the plug which had been screwed in, and pronounced it a hole in the sheet. Of course the brickwork had to be made good again and the owner had rightly enough to foot the bill. This man who was proclaiming himself a boiler inspector turns out to be a cross between a blacksmith and tinker or something of the kind.

I could relate another case where a tramp called on a concern and succeeded in persuading them that their engine was working very uneconomically, and that he was just the man to fix it. In fact he represented himself as an inspector from Messrs. Goldie & McCullough, and said he was going around the country adjusting the valves of their engines. He worked on this engine, which was a Corliss, all Sunday, and "fixed it" as he called it. On Monday he called early and took away twelve good dollars of the firm's money for his services.

The engine did not appear to be right, but the foreman thought she must be in good shape as Messrs. Goldie & McCullough's inspector had fixed her up. However, the superintendent made up his mind to have the engine indicated, and an engineer was sent for. The first card taken off that engine after the "fixing" is shown below, and must be pronounced a "daisy."



Card Taken after Engine was "Fixed."



Card Taken from Engine after Adjusting Valves.

This should prove a warning to steam users to look out for tramp engineers. If an engine is out of order, let them employ a reliable man to put it in order, and not squander their money on the first loafer that comes along.

Above all, lookout for a genius purporting to be an inspector from Messrs. Goldie & McCulloch. If Messrs. Goldie & McCulloch had an inspector to examine their engines, he would carry an indicator and use it, and would not lounge around hotels for two or three days at a time, an example of the effects of too much "fire-water."

Yours truly,

DASH POT.

THE ARRANGEMENT OF STEAM PIPES.

WE have, from time to time, called attention to the importance of suspending and securing steam pipes properly, and providing for their expansion and contraction. In this article we wish to call attention to a common but dangerous method of connecting boilers with main steam pipes.

Fig. 1 shows the way in which the connection is frequently made, the stop valve being near the boiler, and the pipe entering the steam main from below. The action of this arrangement is as follows: The boiler being out of use, entraining water from the other boilers in the battery, as well as water of condensation, settles in the space between the stop valve and the steam main. Then, when the boiler is put in use again, in order to prevent any sudden strain from being thrown on the boiler, the stop valve is not opened until the pressure in the boiler has risen slightly above that in the main steam pipe. When it *is* opened there is a sudden outflow of steam, which raises the water in the connections, throws it against the first elbow, and, if that does not break, hurls it the full length of the horizontal pipe against the second elbow, and then up into the main steam pipe. The shocks so produced are greater than would be imagined by one who has not had experience with water-hammers. In one case that came under our observation recently, *three* elbows were fractured in succession from this cause. When the first one broke the superintendent of the mill considered that there must have been a flaw in it. It was replaced by another, which lasted only a few days. A third elbow was put in, with a precisely similar result, and by that time the superintendent had become satisfied that something was wrong with the arrangement of the piping. The defect was pointed out to him, the pipe was re-arranged, and there has been no trouble since.

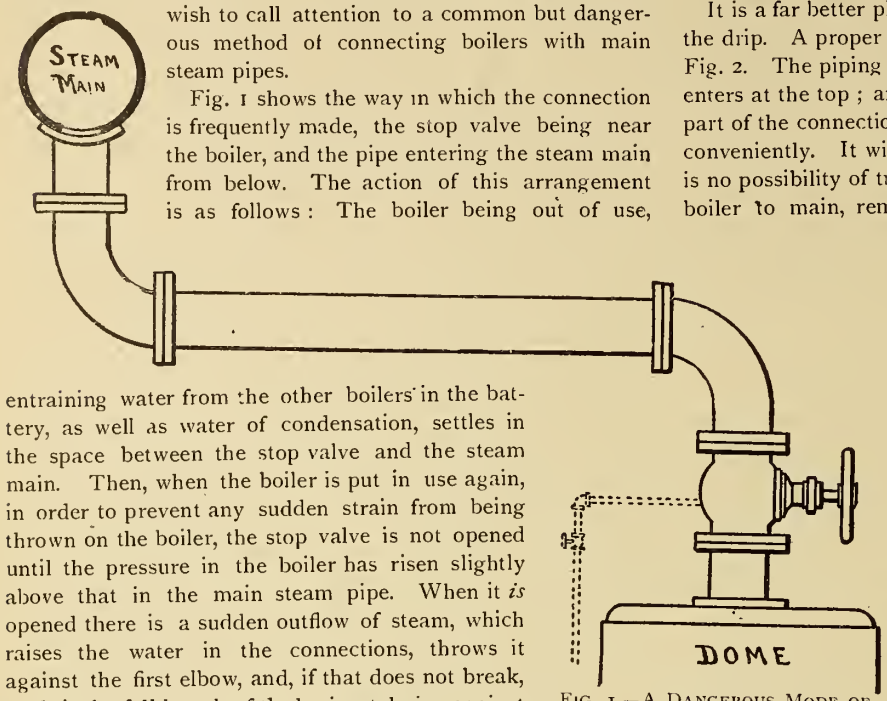


FIG. 1.—A DANGEROUS MODE OF CONNECTION.

It might be said that the stop valve should be opened when the pressure in the boiler is just *equal* to that in the main. This is true, but it is not easy to determine, with any degree of precision when these pressures *are* equal and the engineer very properly prefers to err on the safer side, and have his boiler pressure a trifle too great, rather than too little.

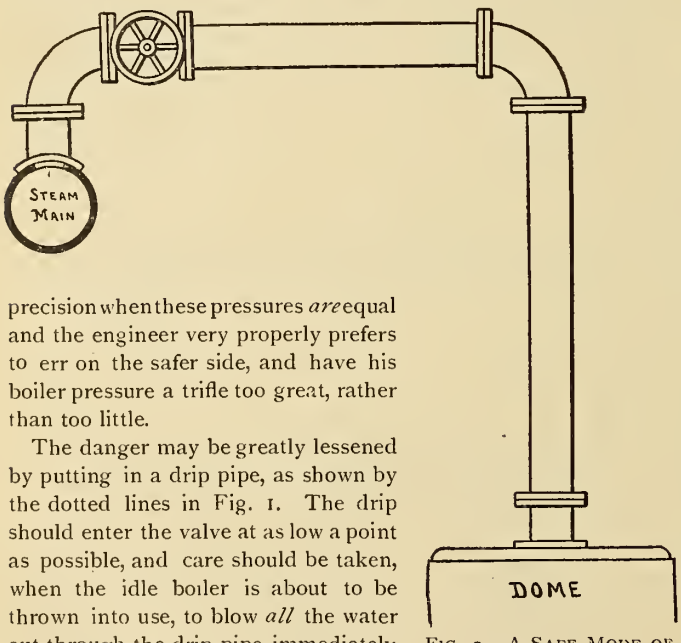


FIG. 2.—A SAFE MODE OF CONNECTION.

The danger may be greatly lessened by putting in a drip pipe, as shown by the dotted lines in Fig. 1. The drip should enter the valve at as low a point as possible, and care should be taken, when the idle boiler is about to be thrown into use, to blow *all* the water out through the drip pipe immediately before opening the main stop valve. If this were carefully attended to each time, the arrangement of piping shown in Fig. 1 should give no trouble; but it is a matter of every day experience to find engineers, who perhaps do not fully recognize the importance of the drip pipe, growing somewhat careless about it. After they have used it conscientiously fifteen or twenty times, there is a tendency to slight it a little, and open the main valve before the water is all out. If no trouble results, this is apt to fix itself on the man as a habit; and some day, when he is in a hurry, he may pay no attention at all to the drip, but open the main valve at once, exposing himself to the danger described above

It is a far better plan to fix the pipe right, and do away with the drip. A proper arrangement of the connections is shown in Fig. 2. The piping passes up above the steam main, which it enters at the top; and the stop valve is placed in the horizontal part of the connection, and as near the steam main as it can be, conveniently. It will be seen that with this arrangement there is no possibility of trapping water. The entire connection, from boiler to main, remains dry, and no water-hammer action is possible. Fig. 3 shows another way of arranging the connection so as to avoid the trapping of water. In this arrangement the pipe enters the steam main at the side, the elbows are done away with, and an angle valve is used to connect the horizontal and vertical pipes. A perspective view of this method of connection was given in *The Locomotive* for May, 1892, on page 66. When new work is being put in, we usually recommend the arrangement shown in Fig. 3; but if the piping has already been put up, in the manner shown in Fig. 1, or in any similar manner that involves the same element of danger, the arrangement shown in Fig. 2 is cheaper to put up, because it enables one to use the same valve that was in use before.—*The Locomotive.*

EXPERIMENT WITH A STEAM BOILER.

THE author of a paper read to the Institute of Civil Engineers has been experimenting with a boiler:—

In calculating the evaporative capacity of boilers, it is usual to reckon it at so many pounds per square foot of heating surface. But the author is of opinion that this method is not sufficiently accurate to determine the maximum evaporation at any given point, since evaporation is not and cannot be uniform throughout a boiler. A boiler becomes overheated at its hottest part, that is, the part subjected to the greatest heat, and the largest quantity of water will be here evaporated. To study the phenomena of overheating, the effects of heat at this particular point, and the amount of evaporation from it must be determined. The author isolated a portion of a boiler plate immediately above the bridge, where the heat is known to be greatest and overheating most frequently takes place. He placed upon it a small vertical iron tube, which was firmly bolted to the bottom of the boiler; the top of the tube rose above the level of the water and opened into the steam. The tube was fed through a separate pipe with water at the same temperature as that in the rest of the boiler, and the quantity of water evaporated by this limited area of heating surface was carefully measured.

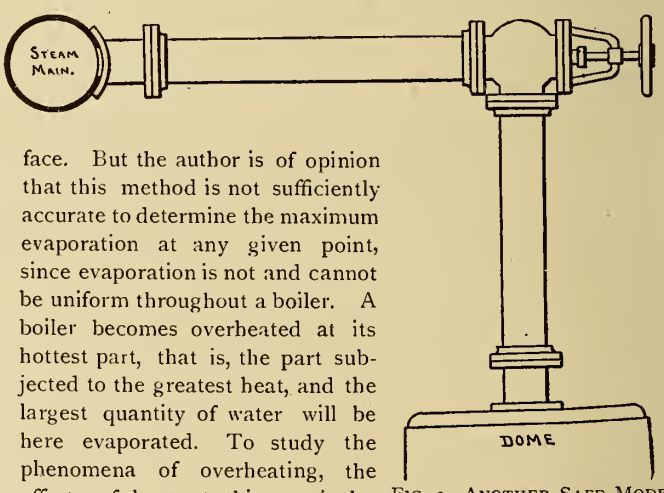


FIG. 3—ANOTHER SAFE MODE OF CONNECTION.

The experiment was made on a cylindrical boiler, with four separate lateral feed-water heaters. The boiler was 10 feet long, and 2 feet 2 inches in diameter, with a heating surface of 35¼ square feet; heating surface of the feed heaters, 107½ sq. feet; total, 142¾ square feet. The grate surface was 3.85 square feet, and a blower increased the draft when a stronger fire was required. The small experimental tube was 4 inches in diameter, with a heating surface 19.3 square inches, bolted to the boiler, and the joint made with asbestos and india rubber. The tube was connected to the water gauge of the boiler, and

the same level of water maintained in both. Previous to an experiment the boiler was heated for several hours, and communication was then cut off between it and the experimental tube. During the trials the pressure in the boiler was kept at about 60 pounds. The fire was stoked as usual, the consumption of coal noted, and the total evaporative power of the boiler determined.

With different intensities of fire, the consumption of coal per hour per square foot of grate varied from 16 pounds to 48 pounds. The author, however, does not advocate such excessive duty, and considers that any consumption of coal above 30 pounds per square foot of grate represents a rate of firing inconsistent with the safety of the boiler. As a rule, with stationary boilers having the above proportions of heating to grate surface, from 1.6 pound to 2.4 pounds of water are evaporated per hour per square foot of total heating surface. Here the maximum evaporation was 94 pounds, and the minimum 19 pounds, or from two to four times as much as in a locomotive boiler. Evaporation was extremely active from the portion of the boiler surface covered by the tube, varying from 30 pounds to 49 pounds of water per hour per square foot of heating surface with moderate firing, and from 40 pounds to 48 pounds with strong firing. The forced draft increased combustion but not evaporation. The author concludes that, with stationary boilers working under ordinary conditions, evaporation at the part most exposed to overheating ought not to exceed 20 to 28 pounds of water per square foot of heating surface per hour, and never attain to pounds in practice.

NEW TECHNOLOGICAL BUILDINGS, MONTREAL.

The new Technological Building in connection with McGill University, Montreal, is a most substantial structure, and its perfect adaptability to its purpose, evidences the painstaking thought bestowed upon it by the designer. The various parts of the building are isolated from one another by fire-proof doors. They include draughting rooms, pattern rooms, machine shop and blacksmith shop, each fitted with the appliances necessary for imparting instruction of a practical character to the students, and one of the best equipped testing laboratories in the world. This laboratory contains two testing machines, representing the most perfect English and American patterns, each with a capacity of 100,000 pounds. These machines are operated by means of a small electric motor. They are capable of determining both the tensile and crushing strength of materials. The laboratory also contains a chemical balance capable of weighing 125 pounds or the fraction of a grain, a *fac simile* to a small scale of the Montreal water works, by which the head of water necessary to supply a given population may be determined; apparatus for measuring the volume and rate of flow of water in a running stream, etc.

Here may also be seen the only standard cement testing department in Canada.

Other features of interest are the electrical department, which contains a 250 h. p. dynamo driven by a sixty h. p. engine. There is not a belt in the place, the dynamo being driven straight on end. There are two engines each 500 h. p., and the space occupied by each engine is only 5x9 feet. The bottoms of the engine beds are hollowed out, which has the effect of preventing rocking. This department is in charge of Prof. Workman, and possesses every facility for imparting electrical knowledge of a theoretical and practical character.

One of the most interesting and valuable features of the institution is the library, which contains 6,000 volumes of scientific books, being one of the most complete libraries of its kind in the world.

At the top of the building, enclosed in glass, is a museum of mechanical models, which for completeness is said to be unequalled anywhere in the world. These models are the work of a celebrated German maker named Releaux, and were many of them made expressly for this institution. They illustrate almost every conceivable mechanical movement, and will be of great service, not only to the students of the school, but also to manufacturers and inventors. They are valued commercially a $8,000.

The Physics building, which is as yet incomplete, seems likely to be as perfect in its arrangement and appointments as could be desired.

TESTING DYNAMOS.

By Foree Bain.

Electric business generally is done in a most unbusiness-like way. A purchaser orders of the manufacturer a dynamo of the desired capacity; the purchaser gets the machine into position, puts the belt on, turns the switch and off she goes—that is, if she goes at all. If the dynamo does not start off immediately and bring all the lamps and everything else in the circuit up to the expected point of excellence, or if, from some similar cause, the dynamo doesn't "generate," it is at once condemned. The cause of the trouble may be an open circuit, or it may be the connections are not made correctly.

There are a great number of reasons why a dynamo will not always start up at once and all of the reasons should be looked into before judgment is passed. I have seen engineers spend weeks to find the "pound" in their engine and they did not "damn" the man that made the engine because it pounded. An engineer knows that there is a reason for it, and sets to work systematically to find the cause. But let a dynamo get out of order, and this same man will lose his head at once. I once went 150 miles to put a brush down on the commutator of a dynamo. An engineer of a certain plant in a large establishment in a sister city had been running a 1200-light incandescent plant for more than a year. Finally when he started up one night one of his dynamos would not "generate." He had "looked everywhere for the trouble," and gave it up. I was sent for, and in a few moments, by a little systematic testing, discovered that the upper brushes did not touch the commutater by a small fraction of an inch. The stem on which the brushes were mounted had become slightly loose and had turned back enough to lift the brushes from contact with the commutator. The brush holders were of the kind having a limiting stop each way. The remedy was, of course, very simple. The trouble could have easily been found by the engineer had he used a little "horse sense" and as I have before said a little systematic testing; I do not always mean by this, a series of guesses, but tests based upon sound judgment. Go off in a corner and think it out, but do not hop around and try a dozen different things without knowing the reason why you are doing them. It is seldom that trouble of this kind is cured accidentally.

I went to Milwaukee one time to find the trouble with a large Brush Arc machine. The dynamo man said he had not been able to find the trouble, and that it had not worked for three days. It seems incredible when I relate the cause to have been that one section of the commutator had been removed and was missing. How the man in charge could have failed to discover it is more than I can understand, but he was ignorant of the fact until I pointed it out. If I thought it would make interesting reading I could relate, I venture, at least, one hundred as ridiculous cases as these, where a little thinking and a general knowledge of the machines in charge could have saved time and money to the owners. I will not attempt in this article to describe how these tests should be made in order to locate trouble, for there are hardly any two cases alike. It will therefore be necessary to adopt a systematic method which I will endeavor to present at another time. There are two sides to every story and the engineer or dynamo men are not always to blame. The owners of plants should not look to them for all the trouble that occurs until they have first performed all they should before the plant is given into their hands.

Every plant that is put in should be tested, "received" and accepted by an independent and competent electrical engineer, one who is in business for himself and expects to remain so, so that he could give a fearless and honest opinion to his employer. He should closely examine the dynamo for capacity, insulation, continuous run, efficiency and an important and often overlooked quality, mechanical construction. And then come in a number of minor features which should be looked after: inductive velocity of the armature—it may be greater on a drum than in a ring armature; rise of temperature on full load should receive close attention; hysteresis and foaucault currents are much more noticeable in badly constructed and proportioned machines than is usually suspected. I have known a case where these two ever present evils have absorbed more than ten per cent. of the power of the dynamo. The heating of switch contacts and other joints should be noted, the resistance of the circuits as a whole, and in sections, should be measured. In fact, every condition should be carefully noted. If the dynamos are compounded, see that the rise with load corresponds with this loss in line, also be careful to note if there is more than one compound dynamo, whether the equalizer is large enough. The resistance of the equalizer should not be less than one-half the resistance of the larger armature.

There are numberless points of this kind that should be carefully inspected by a competent man before a plant should be accepted, and I believe that if owners understood more of the importance of these seemingly little points—but, in fact, very important factors to the success and economical maintenance of every plant—that there would not be so many butchers in the business manufacturing electric light apparatus to-day.—*Electrical Industries.*

The blue glass insulators, heretofore used on telegraph wires, have always had an attraction for the stone throwing boy, and in consequence, a considerable loss has been entailed on the companies. The experiment has been tried of substituting for the blue glass, insulators of an inconspicuous shade of color, and the result is highly satisfactory. The breakages have thereby been reduced by about 50 per cent. As the result of the experience thus gained, the companies will hereafter use only insulators of the kind last mentioned.

RECENT IMPROVEMENTS IN ELECTRIC TRACTION.

A committee appointed to deal with the above subject reported to the Street Railway Association of the state of New York at last convention as follows:

We understand anything which tends to an increase of reliability or economy of operation of an electric railway to be an improvement, and it is with the intention of bringing before you in a brief manner the results of my experience and observation during the past year, upon these points, that this article has been written.

As you of course know, electric systems as first constructed were built on altogether too light a plan, and the increasing tendency year by year has been, and is, for heavier and more solid construction in every department, but particularly in the way of track station equipments. It has been well said that no new departure is ever perfect at the beginning, and no one realizes this more than he who has watched the development of electric traction during the last few years.

The storage battery has made but little progress during the past year and is not likely to cut much of a figure in electric traction until it is able to make better showing, financially, than it has in the past.

It may seem strange that the management of roads, even at present operated by horses, cannot see that a change of some kind must come soon owing to the great cry for rapid transit, and yet I know of roads at present being laid with flat center-bearing rails on stringers in streets being newly paved. I do not mention this as an improvement, but simply to show that what may be regarded as an improvement by some would be called simply a makeshift or temporary piece of work by others.

The general tendency of the times to consolidate all common interests under one management is showing its efforts in electric traction more now than ever, and scarcely a week passes that we do not hear of some syndicate obtaining control of some horse road, and the information usually ends with the statement that "it is intended to equip all the lines with electricity." From many points of view this is an improvement, and a marked one.

TRACK.

The improvement in track construction has been very great, and, although many expensive errors have been made, we ought, on the whole, to feel satisfied with the progress.

The early forms of track construction were tyo light and soon went to pieces, but during the past year heavier rails have been rolled and better joint plates made, so that it is possible to keep the road bed in perfect line and surface. This improvement has been a great help to the electric equipment and has reduced the cost of maintenance. As the cost of laying tracks is about the same, whether light or heavy, it is economy to put in only the best.

Now, on the question of what constitutes the best form of track there is considerable variance of opinion My experience and observation has convinced me that the deep girder rail, about nine inches high, spiked directly to the ties, is the best form for paved streets, and, in dirt or Macadam streets, a six-inch girder rail laid in the same manner. In the country where the local authorities are willing, I would lay a tee rail spiked directly to the ties.

The weakest place in all forms of track construction is at the joint. Every manufacturer of rails, and many of the railroad companies, have tried to overcome this trouble. There are probably as many patents upon rail joints as upon car couplers, and most of them about as impracticable. Up to the present time there has been nothing brought out which surpasses a properly designed "fish plate."

While speaking of track construction it might be well to call attention to the bonding of rails for the return circuit. Many forms are used and some of them are still in operation. I believe that a copper-bond wire long enough to connect with the web of the rail on each of the fish plate to be the best plan, and then grounding the whole system at frequent intervals, and abandon the supplementary wire which it has been the custom to use with the common form of bonding.

ELECTRIC EQUIPMENT.

Probably the greatest advance in any particular line has been in the matter of armatures for motors and dynamos. I consider that the introduction of the "iron-clad" type will do more toward reducing the bill for repairs in that direction than any other one thing that has been introduced during the year. The electric companies have all, I believe, now adopted this form as their standard, and all roads that have tried them will, I think, agree with me that for simplicity, ease of repair and ability to stand the hard usage they receive they stand at the head.

In the manner of controlling the motors most of the companies still use the time-honored rheostat, although I believe one company is endeavoring to introduce a new type of controller which they will doubtless be happy to explain at a later date.

Many roads acting under a misapprehension of the requirements, started off with motors too small for the work, and endless trouble has been the result. Some new classification should be adopted by electrical companies for designating the power of their motors, as the present "office classification" does not afford a proper understanding of its capacity, and the "horse power" term is but little better, depending on so many limiting conditions. A more satisfactory way would be to specify the number of pounds the motor can pull at different speeds, with the maximum current for which it is designed.

THE POWER STATION.

This may rightly be called the heart of an electric system. The trolley and feeder wires form the arteries, the rails and return wires the veins, and the cars the capillaries connecting them. The Biblical injunction to "guard thy heart with all diligence, for out of it are the issues of life," would certainly seem applicable to the station. The chief element to be considered should be reliability, and after that economy. Just what means shall be used to attain this end seems so far to be a disputed matter, as shown by the stations now in operation, which contain almost every conceivable device—good, bad and indifferent; all shapes, sizes and descriptions of engines, boilers and dynamos. Many designers of stations—if some of them can be said to have been designed at all—seem to have gone at their task utterly regardless of the future and oblivious to the experiences of the past. However, through it all I can say that a very marked improvement is observable lately. The designers of stations are learning wisdom from their past experiences and the makers of apparatus are more alive to the requirements of the system, and better material and workmanship can be had where required.

The recent introduction of large multipolar dynamos has brought about a change in station arrangements not heretofore obtainable, and in all large stations now being built countershafting is dispensed with entirely and the general tendency is toward reduction of parts, which in turn means simplicity. It is very probable that we have reached now a form of station that will be fairly permanent and the main point in the future will be the size of the units. For medium-sized stations engines with releasing valve gear bolted direct to a multipolar dynamo will be the best where the price of land is not excessive, and direct coupled engines and dynamos for larger stations. To my knowledge there have been no comparative tests made as to the economy of the various types of stations, although all reasoning would point to these latest types as being by far the most economical.

There has been heretofore too much taken for granted or assumed in electrical work, and the rapid growth of the business has called into it many who were totally unqualified for the positions which they have obtained. I attribute much of the unsatisfactory work in the past to this cause, but am happy to note that the great majority of these are passing into the background and their places are being filled with men of good judgment and mechanical resources.

TRUCKS.

The first car trucks employed in electrical work were of the pedestal form; that is the trucks were fastened to the car body and oscillated with the car. The motors, of course, had to be suspended from the car body, and the result was that the grinding of the gears was transmitted to the whole car, also the oscillation of the car body caused the motors to correspondingly rise and fall. This was very undesirable and it was soon found necessary to adopt the post form—in which the truck was complete in itself and the motors supported directly on the frame of the truck. The body was connected with the truck only by springs, thus being entirely free from the jolts and pounding of the truck.

In this form eight spiral springs were first used, the same as

in the previous styles, but it was soon found that the high speed attained caused the body to oscillate to such a degree that it became very objectionable, and the different builders then modified their trucks by extending the side bars beyond the axle boxes a sufficient distance to allow an auxiliary spring to be added at each end. For this auxiliary support coil and elliptical springs have been used, both forms with marked success, and it is now possible to carry a car body twenty-eight feet over all practically without oscillation. This last modification has been a very great improvement and has settled the long car question on most street railways. I mean by this that but very few double truck cars will be used, though of course there are places where two trucks can be used to advantage, and in such places they will still be employed. But we are able to carry nearly as many people on four wheels as on eight, and to apply the power equally on each axle, so that as there is no possibility of lack of traction, there can be no gain to the railroad company in using eight wheels.

CARS.

The car bodies first employed were of the same style and proportions as those used for horse roads, and were not properly designed for electrical purposes; first the framing of the roof was too weak and would not support the trolley board properly; second, the framing of the floor was not adapted for the use to which the cars were put, for not only was the framing too weak, but it also was not well planned for putting in the trap doors which are required in order to inspect the machinery underneath the floor.

The car body which it seems to me is best adapted for the present service is one eighteen feet six inches long inside, with platforms three feet six inches long. The rafters should be strengthened with steel plates and the framing throughout should be heavier.

The coloring of cars and the necessary signs are attracting considerable attention from the different railway companies, but up to the present time I do not think any concerted action has been taken. For my part I believe that all the cars on a system should be painted the same color, that is to say, each separate line should not have a distinct color, but signs should be used to designate the different routes, preferably by means of the well-known reversible sign on the top of the car, both at the sides and front. All night the lines may be distinguished by the color of the ventilator glass, which would in each case be the same as the ground color of the reversible sign.

OVERHEAD CONSTRUCTION.

There has been a general improvement in all parts of the overhead material. We are using the stiffer poles, stronger span wires, better trolley wire insulators and handsomer curve fittings, so that the general appearance of the system is much pleasanter. The quality of insulation now in general use is far superior to what we had two years ago, and, as double insulation is now employed on the span wires, very little trouble from leakage is experienced.

The method of feeding the line is a very important matter and should receive careful attention. The best arrangement is to divide the system into several sections, so that in case of trouble along any portion of the line, such as fire, etc., that section can be cut out and the balance of the system run as usual.

A PERFECT OVERHEAD ELECTRIC CONSTRUCTION.*

By Charles H. Smith.

The president has appointed me a committee on "A Perfect Overhead Electric Construction." In thus selecting me to prepare a paper on this subject, he evidently intended to pay a passing compliment to my imaginative or inventive powers. He asks me to describe something that does not exist, something that I have never seen, although I have searched diligently for it. I can, therefore, give only my ideas of how an electric overhead line should be constructed, based upon facts and information derived from personal experience and observation.

Iron or steel poles have proved to be the most desirable. I would therefore recommend the following: the poles to be of tubular iron 32 feet in length, and made of three sections, in the usual way. The lower section should be at least 7 inches in diameter, and the other two sections 6 inches, and 5 inches, respectively. The poles should be set in concrete, and at least 6 feet in the ground, and should not be more than 125 feet apart. The top of the pole should have about 2 per cent. of rake away from the curb, and should be fitted with a suitable pole clamp, so that the span wire can be easily adjusted to the required height, which should be 22 feet above the track. On top of the pole should be a malleable iron cross arm to carry the feeder wires, and guard wire spans. This cross arm should be insulated from the pole by means of a wooden plug inserted in the top of the pole. The insertion of the joints of the pole should be at least 18 inches, and the joints should be made solid throughout their entire length by means of shims or other contrivances. If these joints are not properly made, the poles will not stand the strain. For curves or extra strain, there should be larger poles of the same make.

Span wires should be of No. 4 B. W. G. silicon bronze wire and should be fastened to pole clamps by means of insulated turn buckles. Great care should be taken in insulating these turn buckles from the poles.

All well-built lines should be sectional, and the trolley wire should not be of too great a size. I would therefore recommend No. 4 B. W. G. silicon bronze wire, which affords sufficient carrying capacity and has great strength and durability.

Sections should not be of a greater length than two miles, and should be separated by trolley breakers, of which there are now a number of good ones in the market. In cities and villages where there is great liability of fires it would be advisable to put trolley breakers at short intervals. Trolley wire hangers and pull-off brackets should be of the lightest make possible, and still have the required strength and the very best insulation. There is a variety of such hangers and brackets now in the market.

As it is important to have as small a number of joints as possible in the trolley wire, it should be put up in mile lengths, and twisted splice joints should be made and brass cone shaped slipped over the wire before the splice is made. After completing the splice, the larger ends of the tubes should be brought together over the splice and a little solder dropped through a small hole made in the tubes for that purpose, in order to keep the joint in place.

Overhead switches or switch pans, should be avoided, if possible, as they become a source of great annoyance. I would strongly recommend a double trolley wire for a single track road.

Great care should be taken in erecting the guard wire spans. They should be properly insulated from the cross arm by means of a strain insulator, or something equally as good, and should be of at least No. 6 best galvanized iron wire. There should be two guard wires over each trolley wire at least three feet apart and four feet above the trolley wire. The guard wire must be well insulated from the guard spans; in case of other wires falling, this would be of great importance. Pull-off and anchor guy wires, or other wires for the same purpose, must be of the very best material, and of at least No. 8 galvanized iron wire.

Feed in taps must not be more than five poles apart and should take the place of trolley span wire at that point. They should be of at least No. 0 insulated wire.

The trolley wire being sectional, it is necessary to run a feeder wire to each section. I would, therefore, recommend that the feeder wire be at least 30 per cent. larger than the occasion demands. It will be found that this is money well invested. The insulation on the feeder wire should be the best that can be procured, and I would advise using locust or iron pins with mica insulatiors or something equally as good, for the purpose of fastening the feeder wire to each pole, and great care must be taken to protect it from trees and other obstructions.

A cut-out box should be located on the pole at each trolley breaker, and should not carry a fuse. It should have the same wire running through it as there is on the outside. The fuses should be at the station, with ampere meter and cut-out switch for each section; then in case of trouble on any section, the location can be easily seen, and that section cut out, if necessary, until repaired.

Lightning arresters are of great importance on the line, and I would strongly recommend using them at least every thousand feet. They can easily be attached to the poles, and can be protected by means of a box.

In conclusion, I would say that no matter what expense is incurred for material, or care used in constructing, a good line cannot be insured without a thorough daily inspection.

*Report of a committee of the American Street Railway Association, read at their Cleveland meeting.

Mr. A. Carmichael and Jacob Hose have purchased the Rat Portage Electric Light, Telephone and Power Company's interests, and took possession of the property on the 1st of October.

The Toronto and Scarborough Electric Light and Power Co. has been established, and arrangements are being made to begin immediately the construction of an electric railway from the Woodbine to Little York, in East Toronto. This line is to be completed and put in operation before the end of the present year. The directors of the company are as follows: D. G. Stephenson, Reeve of East Toronto; Ald. Hallam, J. F. McLaughlin, W. T. Murray, J. J. Foy, Q.C., Robert Davies, J. P. Murray, John Stark, H. M. Pellatt and A. W. Dingman. The officers are: President, D. G. Stephenson; vice-president, Ald. Hallam.

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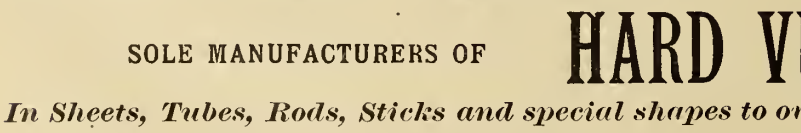


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SPARKS.

The Toronto Technical School has decided to purchase $300 worth of electrical apparatus.

Mr. G. Hazlett, recently with the Kingston Electric Light Co., has been appointed chief engineer of the Winnipeg electric light station.

Mr. Walter J. Wiggett, of the office staff of the Canadian General Electric Works at Peterboro', was married recently to Miss Gertrude May, daughter of Mr. A. Grover Heath.

It is reported that the Quebec and Levis Electric Light Co. have purchased the Montmorenci Falls, with all water power rights, buildings, etc., at the price of $235,000. The company has been paying about $5,000 per year for the power necessary to operate its circuits, and as additional power was required for this purpose, it was no doubt deemed advisable to purchase outright the whole of the available power.

The Brantford Electric Lighting and Power Co. has been organized, with a capital stock of $150,000, to acquire the interest of Mr. A. Watts, in what is known as the "Grand River level," together with the plant, buildings, etc., of the existing electric light company. It is proposed to expend the sum of $30,000 on the erection of a stone dam and other improvements. It is estimated that on the completion of these improvements the lands will be worth $20,000 above the cost of reclaiming them, and that 300 horse power will be available.

Mr. John Patterson, of Hamilton, is the prime mover in a scheme for bringing electricity from Niagara Falls to Hamilton for power purposes, and for the operation of electric railways connecting with a number of the leading towns within a radius of 40 miles of that city. The total cost of carrying out the scheme is estimated at $2,500,000, and the city of Hamilton is asked to subscribe $400,000 of stock. Articles of incorporation are being applied for. It is proposed to erect the power house on the Canadian side of the Niagara River.

The Brush Electric Co. of Ontario, Limited, is seeking incorporation, with the object of generating and supplying current for electric lighting, heating and power in the town of Trenton, and for the manufacture and sale of electrical machinery and apparatus, and to acquire the right to furnish and operate electric railways within the province of Ontario. The headquarters of the company will be at Trenton, and the amount of its capital stock $25,000. The promoters of the enterprise are: William Scudder Rogers, Samuel Marion Hamill, John Potter, William B. Bolton, of Cleveland, Ohio; Gilbert Wellington Ostrom, William Joseph Clarke and Robert Fraser, of Trenton. William S. Rogers, Samuel M. Hamill, John Potter, Wm. B. Bolton and Gilbert W. Ostrom are to be the first directors of the company.

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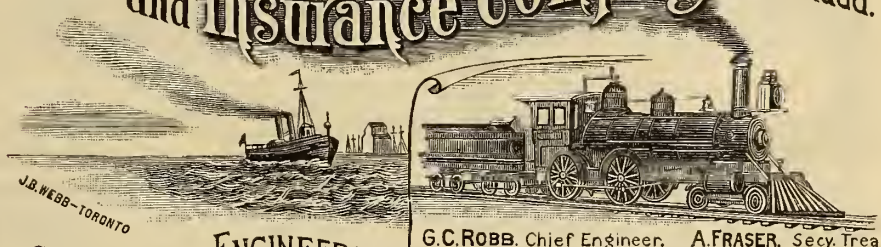
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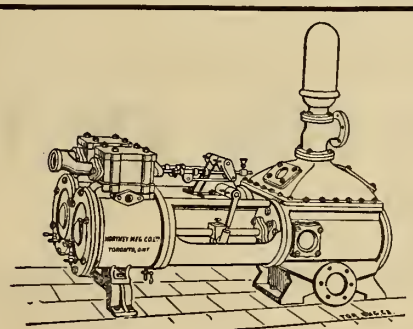
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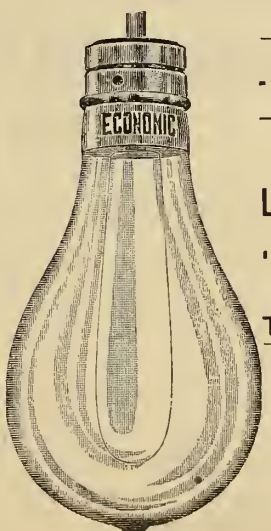
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SPARKS.

The Victoria and Esquimault Telephone Co. are remodelling their whole system, at a cost of $15,000 to $20,000.

The Hamilton Street Railway Company paid into the city treasury the sum of $3,436 as the city's portion of profits and mileage fees for the quarter ending September 26th, an increase of $1,226 over the previous quarter.

The Hamilton, Waterdown and Guelph Electric Railway Company, Limited, with a capital stock of $500,000, is seeking incorporation from the Ontario Government. The directors are: Sir W. P. Howland, Toronto; Wm. Laking, W. Oscar Sealey, Alex. W. Brown, Jacob Flatt and Wm. D. Flatt, Hamilton; John I. Flatt, John Nicholson and Leopold Bauer, East Flamboro; and Fred. Slater, Dr. John O. McGregor and Charles Sealey, Waterdown.

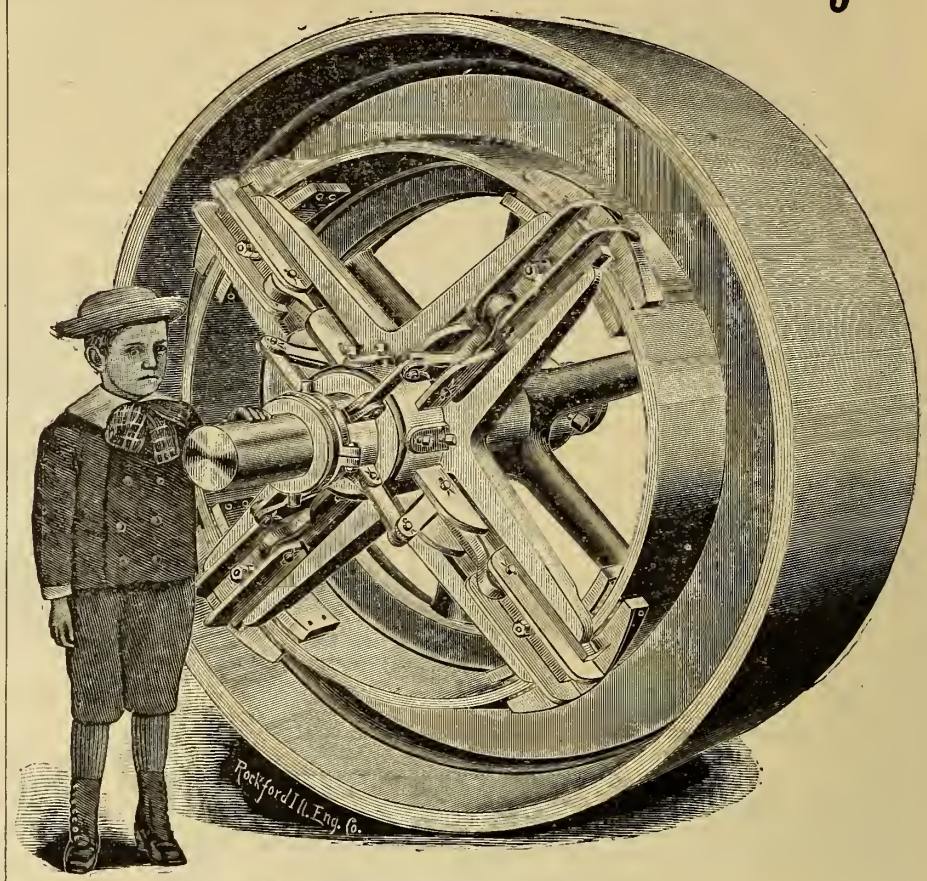
IT MAY BE INTERESTING TO KNOW

That when excursion rates are made to Chicago for people who live in the East, to enable them to attend the World's Fair next year, it is contemplated by the Western roads to also make excursion rates from Chicago to all principal business and tourist points in the West, Northwest and Southwest. It may be well to consider this subject in advance of the actual time of starting, and the Chicago, Milwaukee & St Paul Railway Co. has issued maps and time tables and other instructive reading matter, which it will be glad to furnish free of expense upon application by postal card addressed to A. J. Taylor, Canadian Passenger Agent, 4 Palmer House Block, Toronto, Ont., or to GEO. H. HEAFFORD, General Passenger Agent, Chicago, Ill.

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I am, yours truly,
J. C. FERGUSON,
Chief Engineer Toronto Water Works.

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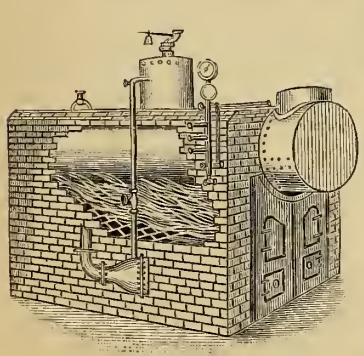
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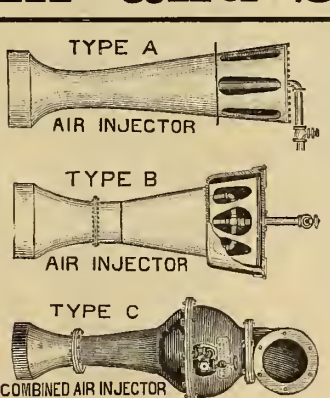
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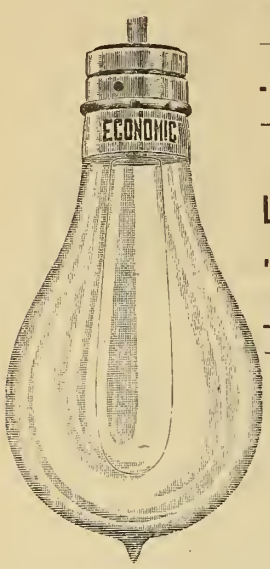
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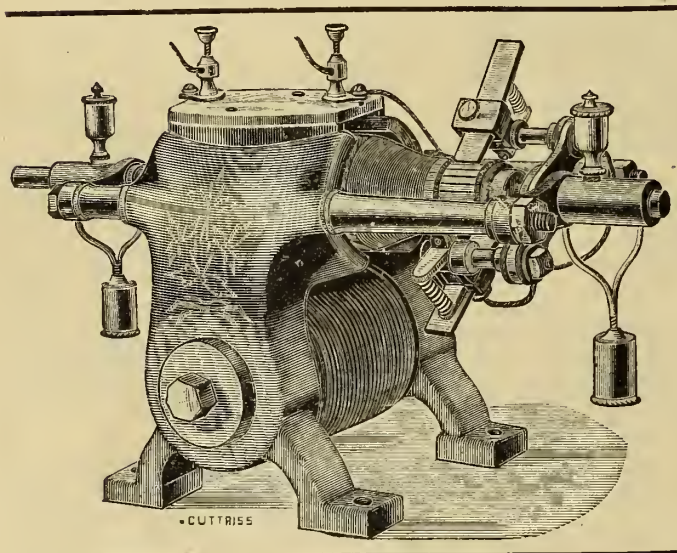
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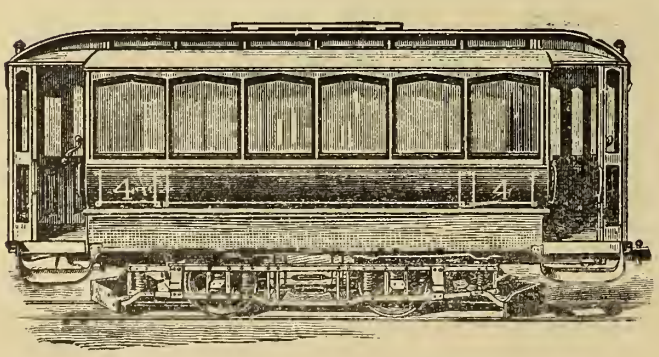
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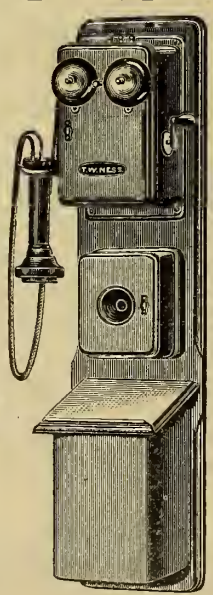


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CANADIAN

ELECTRICAL NEWS

AND

STEAM ENGINEERING JOURNAL.

VOL. II. TORONTO AND MONTREAL, CANADA, DECEMBER, 1892. NO. 12.

WINNIPEG ELECTRIC STREET RAILWAY.

THE accompanying illustration pictures a scene at the inauguration of the Winnipeg electric street railway.

The road was put in operation on the 5th of September last, the start being made from the city hall square at two o'clock, in the presence of thousands of citizens. An invitation had been extended by the management to the members of the Local Government, City Council, Board of Trade, and to leading citizens to enjoy the first trip over the line. On the initial trip, which was very successful, there were about 300 passengers aboard the cars.

On returning to the city hall a vote of thanks to the management for the energy shown in the construction of the road was moved by the mayor and seconded by the Secretary of the Board of Trade. The vice-president, Mr. Wm. White, and the manager, Mr. G. H. Campbell, responded for the company.

Much enthusiasm was manifested by the citizens, the completion of the road being regarded as likely to aid in no small degree the advancement of the city's welfare.



SCENE AT THE INAUGURATION OF THE WINNIPEG ELECTRIC STREET RAILWAY.

A deadlock has occurred in the Lachine Council on the question of awarding the contract for the construction of an electric railway between Lachine and Dorval. Tenders have been submitted by the Canadian General Electric Co. and by Mr. Bickerdike.

CANADIAN ELECTRICAL ASSOCIATION.

A MEETING of the Executive Committee of the Association is being held to-day (Dec. 1st) in the offices of the Bell Telephone Company, Toronto, to further the arrangements for the January convention.

Three or four papers on as many subjects of interest to members engaged in the various departments of the electrical field, are already in course of preparation, and others are being arranged for.

The School of Practical Science, in which, by the kindness of the authorities, it is proposed to hold the convention has a very fine physical laboratory, including a full equipment of electrical machines and instruments, which, with the other features of the institution, will alone afford much interest and instruction to the members.

Visits of inspection will be arranged to the Toronto Electric Light Company's central station, in process of enlargement to double its former size—and one of the largest stations on the continent—the new power house of the Toronto Street Railway Co., the Bell Telephone Company's new exchange, the Incandescent Electric Light Co.'s station, and the factories of local manufacturers. An opportunity will also be given of inspecting the Toronto Street Railway Company's system.

These visits of inspection will reveal to the observant visitor

the latest ideas in electrical devices and practice. Although prominence will not be given to the social features of the occasion, they will not be entirely overlooked.

The Committees appointed at the last convention will give a report of their work. Business relating to the progress of the Association and the annual convention of 1893 will call for consideration.

Altogether, the meeting in January promises to be one of interest, pleasure and profit, and the members are urged to assist by means of suggestions and otherwise to make it a success. Especially let every member who can possibly do so make up his mind to attend.

ORGANIZATION OF ENGINEERS AT GUELPH.

On Wednesday, November 16th, A. E. Edkins, President of the Executive Council of the Canadian Association of Stationary Engineers, went to Guelph for the purpose of organizing a branch of the Association in that town. He was met at the station by Mr. John Angell, engineer at the Ontario Agricultural College, and escorted to several places of interest around town before the time arranged for the meeting to take place, which was at 8 p.m.

Through the kindness of Messrs. W. Bell & Co., the use of their draughting room was offered as a temporary place of meeting. At the hour mentioned the following gentlemen were on hand ready to become members of the new Association :

Messrs. J. Angell, P. Ryan, S. C. Cosford, C. Jorden, J. I. Dixon, L. Thompson, Jas. Fordyce, Jas. Tuck, H. Flewelling, J. Thatcher, H. Littlechilds, J. McRae, J. L. Goold, J. McNeil, E. Moodie, R. Green.

A preliminary meeting was held, at which the following officers were elected : President, J. A. Angell ; Vice-President, P. Ryan ; Conductor, S. E. Cosford ; Recording-Secretary, C. Jorden ; Financial Secretary, J. L. Dixon ; Door-keeper, L. Thompson.

Bro. Edkins was asked to explain the aims and objects of the C. A. S. E. for the benefit of a few engineers present who had no knowledge of the Association or its work. Bro. Edkins complied, and after doing so read a part of the Constitution, which apparently satisfied everyone regarding the chief objects of the Association and the work it was intended to do. All present having signified their desire to become members, the initiation ceremonies were proceeded with and the officers installed. Bro. President Angell assumed command of the new association, and in a happy speech thanked the members for the honor conferred on him, and assured them that he would with their united help strive to make Guelph No. 6 an association second to none, and one of which the members of the C. A. S. E. might be proud. General business was then disposed of.

Several committees were appointed, one of which was for the purpose of looking after a suitable meeting place. It was resolved that the association should meet on the first and third Saturday in each month, at 7:30 p.m.

Uneer the head of "Good of the Order," Bro. Edkins was called on by the President for an address, and spoke in substance as follows :

It is a great pleasure to me to come up to Guelph to organize you as Guelph No. 6, C. A. S. E. I have often wondered why the engineers of this city did not band themselves together as a branch of the order, but I am aware of the fact that there is a difficulty in organizing in a place of the size of Guelph that is not met with in a place like Toronto or London, owing to the small number of engineers. There are a number of places in which there are engineers who would like to organize a branch, but unfortunately there are only eight or ten engineers all told in the vicinity, and of these perhaps three or four are unwilling to join, and so for this reason in many cases associations are not formed.

These associations have been the means of doing a large amount of good in other places. By them engineers are brought together for the purpose of assisting each other, and discussing matters of every day interest. In this way each member is sure to gain some information that will help him in one way or another. We are all well aware of the fact that some men did not get the chance to acquire a good education in their youth; this certainly is their misfortune, but as a rule not their fault. An engineer may lack education, but in spite of this he may be a thoroughly practical man, and I am acquainted with many men who are in just this position.

The chief object of the C. A. S. E. is mutual improvement and instruction, and the meetings of associations have been largely devoted to this object ; while we have not by any means overlooked the fraternal feature, such as helping a brother engineer in distress and endeavoring to secure employment for our members who are out of work.

I feel sure that your association here in the Royal City will prosper and be a credit to the order at large, and even though you may be small in number, if you remain true to your obligations and each one does his share of the work in and for the association, you will find that the association will prove beneficial to you all. It will bring the engineers of this neighborhood together as brothers, and be the means of creating a feeling of fraternity such as should be present among any body of men who follow the same employment to gain a living. We have the Locomotive Brotherhood, the Brotherhood of Locomotive Firemen, the Marine Engineers' Association, and many others who have organized for the purpose of helping each other, and it has always been a matter of surprise to me that the stationary engineers of Canada have only made a move in this direction during the last few years.

I am glad to say that at the present time there is a strong feeling in favor of organization all over the country. The C. A. S. E. has spent a good deal of time and not a little money in trying to get an act passed in the Local Legislature for the licensing of stationary engineers. So far we have been unsuccessful in obtaining what we asked, but two years ago the Local House passed a permissive act and appointed a Board of Examiners to examine all engineers requiring certificates and to issue the same.

Up to the present time quite a number of engineers have been granted certificates, yet not as many as we could wish. We do not intend to be content with this, as we believe that what is required in Canada is a law to license stationary engineers, and thus give every steam user a guarantee that the man who applies to him for a position as engineer, has had the necessary experience and possesses the necessary qualifications to enable him to properly discharge the duties of the position to which he aspires. We do not think, or at least I do not think, it necessary that in order for a man to be a qualified stationary engineer, he must have graduated from a technical school, but I do maintain that he should at least have served a sufficient length of time in the boiler room as fireman to enable him to thoroughly understand the care of boilers and feeding apparatus, and if he has complied with this requirement he certainly should be able to pass a practical examination. If an engineer has served time in an engine or machine shop, so much the better, and you will invariably find men of this class holding the best positions all over the country and receiving good remuneration for their services.

I am not one of those who maintain that in order for a man to be a good engineer he *must* have served his apprenticeship in the shop, but what I do maintain is that if a man has served from three to five years in the shop, and in addition to this has had four or five years in the engine room, he certainly must make a good engineer. On the other hand, there are hundreds of men in the country who have worked themselves up from the boiler room by having taken an interest in their work, and while they may have but a limited education, they have the experience, and in my estimation that is what is required. It would not be right or just for any legislature to pass a law for licensing stationary engineers which would shut these men out simply because they could not pass a technical examination or explain the construction of certain parts of an engine or boiler, for there are hundreds of men in charge of stationary engines who have been at the business for years, yet if put to an examination, would fail, simply because they are not versed in the terms and technicalities of steam engineering. These same men, when anything goes wrong with their machinery, know what to do at once, and can do it quickly, but asked an hour before the accident what they would do in such a case, might not be able to answer satisfactorily.

If an act should be passed to provide for the licensing of stationary engineers, it should be similar to the one passed respecting certificates to marine engineers. When the act respecting certificates to marine engineers came into force in 1863 in England, there was a provision made granting certificates to engineers who gave proof of a certain number of years' service in the engine room, &c. These men were entitled to a certificate corresponding in grade to the position they were holding on the boat at the time the act came into operation. They had the experience, yet the authorities knew full well they could not pass the examination.

I believe the engineers on our inland waters in Canada were similarly dealt with, for I know that there are large numbers of them holding third class certificates who could not pass an examination, but who are practical men and had a certain number of years experience, on account of which certificates were granted them.

Looking at the state of affairs in regard to our marine brethren to-day, we find when they come up for examination they have to prove conclusively that they have served as engineers or firemen, as the case may be, on boats of a certain N. H. P. before the Board will examine them at all, and then the examination is severe. The coming marine engineer knows full well what will be expected of him, and consequently he adapts himself to the situation, puts in his time firing or in shop, and prepares himself for examination in his spare time. When the time comes he is ready.

As I said before, if an act is passed providing for the licensing of stationary engineers, it must necessarily, in justice to all concerned, be framed in the manner I have pointed out, and any stationary engineer who can give proof of five years service in the engine room, should be granted a third class certificate. The fatal explosions which have occurred of late prove conclusively that legislation is required to prevent steam users from placing men in charge of steam boilers who have no experience, and as a consequence know little or nothing of the duties they are expected to perform. It is the duty of every member of this association to assist in obtaining this legislation, and we should try and do everything in our power to arouse the public to demand such a law.

It is only a short time ago since I went into the boiler room of a large

manufacturing concern in Ontario and found a man filling the position of engineer who told me he knew nothing about the work. The engineer had left some time before, and he was driving the team when the boss came out and ordered him to go in and take charge of the boilers and engine. He said he knew that if he refused he would be discharged; he had a wife and family at home depending on his weekly earnings for bread. I could see the fix he would be in. He told me he knew nothing of the work he was doing, and when I asked him how often he washed out, he did not appear to understand what I meant. Is it any wonder that explosions occur when such a state of things is allowed to exist?

The law which was before the Ontario legislature three years ago would have passed had it not been for the opposition it met with from members from the saw mill districts, many of whom owned mills and were afraid they would have to pay 25 cents a day more for their engineer, and these are the very men who need licensed engineers most, judging by the number of explosions which occur in saw mills.

In conclusion, I trust that success may attend your efforts in establishing the C. A. S. E. in Guelph, and even though you may be small in number, you are banded together for a good cause, and you can rely on it that the right hand of fellowship will always be extended to you by the members of the different associations.

A vote of thanks was tendered to Bro. Edkins by the President for the address, to which he suitably replied.

Guelph No. 6 is composed of a good lot of fellows who are all practical engineers. Their officers are the right men in the right place. In fact, all the officers and members seem to have plenty of "go" in them, and Guelph No. 6 starts out with every prospect of a long and useful career.

Bro. Edkins was made an honorary member.

CARE OF STEAM BOILERS.

Editor ELECTRICAL NEWS.

LONDON, ONT., Nov. 20, 1892.

SIR,—In the November issue of the ELECTRICAL NEWS you published a paper on "Care of Steam Boilers," by Mr. Albert E. Edkins. I would like to make a few remarks on this very important subject through your columns, as I believe, as stated by Mr. Edkins, that this matter does not receive the careful consideration that it should.

With the knowledge at hand there is absolutely no reason for boilers to explode. There are reliable safety valves; there are reliable fusible plugs, and there are reliable engineers to take charge of them, and what is more, expert inspectors can be secured to inspect boilers at a very reasonable charge.

In the last 40 years the alterations made have not been very great, though they have been important. In the structure of the boiler itself the chief alterations have been in the direction of providing against expansion stresses due to the action of heat upon different portions of the boiler causing differential movements. In details, there have been improvements in the riveting and in the making of the rivet holes.

I regret to say there are still too many architects who provide the worst part of a building for the steam plant unless they are expressly enjoined otherwise. Now, right here is where the employer makes a great mistake. If, instead of an architect, he would consult some first-class engineer as to where the steam plant should be put, how much room should be required for it, and how the brick work should be built, he would find that the life of the boiler would be a great deal longer, and there would be considerable saving on the coal bill.

An employer called on the writer a short time ago and wanted to know the reason why his new brick chimney would not give satisfaction. He stated that although he employed a first-class architect and bricklayers, results from the new chimney were not as good as from the old iron one—in fact, the steam could not be kept up the draught was so bad.

When asked the details, he said: "The boiler is a 35 H. P., the chimney is 4 ft. square at base inside and 3½ ft. square at the top of the flue, and the height is 60 ft from surface."

Would it not have paid this man to engage a first-class engineer in the first place, in which case he would have had a first-class job, whereas as it is he knows not where the expense is going to end.

This is only one instance. A furnace under a boiler into which I looked the other day, as the fireman was shovelling in the coal, might be compared to an old street car open at both ends. Some good consulting engineer would strike quite a harvest if he could be allowed half the saving he could make in the coal bill. The so-called engineer in charge of this plant boasted to me that it was the finest bricked in boiler he ever handled. He said: "I can blow her off, wash out and fill her up again (with water at 50° F.), and then have enough heat left in the brickwork to raise steam to 10 lbs. without any fire."

Now, the city has a by-law in force, and faithfully carried out, which provides that only a small quantity of gunpowder can be kept in or around a store. My opinion is that such steam plants as the above mentioned should be classed as gunpowder in large quantities and should be taken out to some lonely spot in the country, where the "engineer" could be given a fair chance to show his abilities. Still, were such a boiler to explode, some people would think it was a pure accident.

It is high time that an engineers' license and boiler inspection law was in force and faithfully applied. I must say that much credit is due to the Boiler Inspection and Insurance Co., of Toronto, for the able manner in which their inspectors have given safety by inspection and a word or two of good advice to the engineers of this city. I know steam gauges now telling the truth, which were 5 and 10 lbs. out before inspection, and safety valves made good which were absolutely useless. In this direction we ought to set out with the conviction that a boiler is not an article to explode.

FRED. G. MITCHELL.

POWER TO RUN A DYNAMO.

By J. H. GLOVER.

ONE of the most remarkable things about the dynamo-electric machine is its power-absorbing capacity.

It is well known that in operating a mechanical device it requires less power to keep the apparatus in motion after it has been started than it does to start it. In the case of the locomotive, for instance, it requires very little steam to keep the machine in motion after it has started, but it requires great power to start it from the condition of rest. The same applies to electric cars and all other vehicles, as well as machinery. In all, the greatest power is needed to effect the start, after which little power will maintain the motion. Not so with the armature of a dynamo, however, which in its mechanical aspect is no different to any other piece of mechanism.

Naturally, the uninitiated would suppose the armature would run with great facility after it had got started, just as the locomotive does, but exactly the reverse is the case; and it is a remarkable fact that the faster the armature is revolved the greater is the power required to maintain the motion.

The armature of a gigantic 500 H. P. generator may be turned by the hand from a state of rest, so delicately is it balanced, but to run it at a speed of several hundred revolutions a minute requires the energy of a steam engine of great power, and within certain limits the faster we run the armature the more steam power will be required.

Now, what is the reason for this apparent anomaly in mechanics? It is this: When the armature is at rest there exists no magnetic field, the existence of which depends upon the motion of the armature, and the faster we run the armature the denser will the magnetic field become. The elements of the magnetic field consist of what are ordinarily termed "lines of force," and when we speak of a dense magnetic field, it is another way of saying that there are a great number of "lines of force." One of the peculiar properties of the magnetic "lines of force" is that they tend to arrest motion, and in the case of the dynamo the tendency always is to stop the motion of the armature in its revolutions. It is evident, therefore, that the stronger the magnetic field, and consequently the greater number of "lines of force," the greater will be the tendency to arrest motion, hence the greater will be the power necessary to overcome the retarding influence of the field.—*Electrical Age.*

Mr. W. A. Grant, formerly secretary to Mr. Van Horne, President of the C. P. R., has been appointed manager of the Niagara Falls Electric Railway, and will enter upon his duties at once. The railway, however, will not go into operation until the spring.

The Back River Power Co., Ltd., is applying for incorporation at Montreal. Its capital stock is to be $200,000. The applicants are:—John Thomas Wilson, merchant; James Robert Walker, merchant; Gilman Cheney, gentleman; Evans Fisher Ames, manufacturer, and Frederick Milton Cole, insurance agent. The object of the company is to lease or sell water power or electric power to individuals, companies or municipal corporations.

C. A. S. E. BANQUET.

The Sixth Annual Dinner of the Canadian Association of Stationary Engineers was held on the evening of the 9th of November, at the Richardson House, Toronto. About 70 ladies and gentlemen sat down to dinner, amongst whom were noticed the following :

Guests—Messrs. Geo. Grant, Jas. Watson, Wm. Towers, J. Wright, W. S. Brown, Prof. Galbraith, J. Main, R. Hutt.

Lady Guests—Mrs. R. Hutt, Mrs. Wm. Towers, Misses A. M. Wickens, E. M. Wickens, Miss Mortimer, Misses M. Croacke, M. Coutts, L. Coutts, J. Winters, L. Kennedy, Miss Winters, L. Smith.

Members and wives—Mr. and Mrs. J. G. Bain, Wm. Butler, W. G. Blackgrove (President), Mr. and Mrs. H. Caldwell, A. E. Edkins, Geo. Emory, J. Fox, Geo. Gilchrist, Mr. and Mrs. Chas. Heal, D. Jeffrey, Mr. and Mrs. Chas. Kinsey, W. Lewis, P. Myers, Mr. and Mrs. Chas. Mosoley, J. C. Mooring, W. Phillip (V. President) and Mrs. Phillip, E. J. Phillip (Sec'y), William Reveley, T. Rolph, C. Scott, W. Sutton, Mr. and Mrs. George Saunders, E. Tipton, H. Terry, Mr. and Mrs. A. M. Wickens, Jas. Wadge, H. Winters.

An excellent bill of fare was presented, and after full justice had been done thereto, the "Queen" was proposed and drank in royal style. The "C. A. S. E." was coupled with the names of Bros. A. M. Wickens and A. E. Edkins, President of the Executive Committee.

"Our Manufacturing Interests" was coupled with the names of Mr. Brown, of the Glodie & McCulloch Co., Galt, and Mr. J. W. Main, of John Inglis & Sons, Toronto.

Mr. Brown, in responding referred to the growing influence of the C. A. S. E., and the many benefits that had been derived by ts members. The Association was not only beneficial to members, but also to employers, as it enabled them to secure thoroughly capable men. The engines were better taken care of and better satisfaction given in every way.

Mr. Mrain also spoke, expressing the pleasure it afforded him to be present. He had attended several dinners of the Association and always enjoyed himself. He was pleased to see the Association prospering, and hoped that it would continue to advance in the future as in the past.

"Our Educational Interests" brought forth a response from Prof. Galbraith, who said :—"It is with peculiar feelings that I arise to respond to this toast to-night. I think I have been at every annual dinner that you have held since the beginning, and I must say that I never felt so embarrassed as to-night. I think the last time that I had to make a speech in the presence of ladies, that is aside from a written speech or something of that kind, was the morning that I was married, and I observed the five minute rule then I can assure you. I didn't attempt to fill up the time. But, ladies and gentlemen, I think that we must all acknowledge the advance of the times ; ten years ago we never thought of seeing a lady at our classes in the University ; to-day we think nothing of it. (Laughter). The professors are quite accustomed to speaking to ladies ; it is only within the last year that we had the pleasure of addressing any ladies. There is one now attending the School of Science—the first one. I am beginning to get accustomed to it, but it takes a great deal of courage I am sure. But this has quite driven the subject of the toast out of my head. As a change has taken place in the respect that I have just mentioned, so changes have taken place in educational interests with which we are concerned, namely, in technical education. It is only, I think, four years ago since we had nothing but bare drawing tables, seats and blackboards, and a few books. Now we are pretty well fitted out with a large quantity of apparatus and machinery. Within the same period the technical evening school has become a fact. Four years ago your former President, Mr. Wickens, and your present President were working hard with us to get that school established, and we never expected to meet with the success that we have. For the first year we worked in the same way as we have worked for a long time in the School of Science, with very little except mechanical apparatus. This year I am glad to say that the council have given a fairly large grant toward electrical apparatus, and I am glad to say that as time goes on we shall find both of these classes—the School of Science and the Technical School—growing and increasing. I don't fear now that they will fail ; a few years ago we scarcely hoped that they would succeed. I scarcely know what I can say more than I have said on former occasions. One thing perhaps I may say : I promised you for the last three or four years an evening at the School of Science. I promised it so often that I felt sure that you had lost all faith in my promises. However, I determined to be at the dinner to-night and speak a few words to you, and now I think I can take courage and make a further promise, sometime during the coming winter to give you a more extended address—something that will interest you. I am glad to see your society progressing as it is, and from the signs that we see at the end of the table, I am glad to believe that it will never die out.

The Host and Hostess were then proposed, to which Mr. Richardson responded.

After the room had been cleared, the following programme, interspersed with dancing, was gone through :—

Piano solo, Miss Croake ; song (comic), Mr. F. Wright ; duett, G. W. Grant and Miss Mortimer ; song, Mrs. Bain ; song, Mr. Major ; duett, G. W. Grant and Mr. Blackgrove ; song, Mr. F. Wright ; song, Miss Mortimer ; duett, G. W. Grant and and Mrs. Bain ; song, Mr. Major ; song, Mr. F. Wright ; Miss Croake, pianist.

AN AUTOMATIC TELEPHONE.

The Automatic Telephone and Electric Co. of Canada has been organized at Montreal, to introduce an instrument designed to enable each subscriber to a telephone exchange to make his connections without the assistance of a third person at the exchange. Mr. James P. Dawes is the President of the new Company, and Mr. H. M. Linnell, formerly manager for the Edison Co., is to be the managing director. Among the directors are Messrs. John Torrance, R. Wilson Smith, L. M. Dupnis, J. B. Clarkson, J. E. Macdougall, and Alf. Lomas.

The invention, which is said to have been proved by tests to work with entire satisfaction, is thus described by a local paper : It is a device to automatically make the connections in a central exchange and dispense entirely with the services of an ploye at that place. The method by which this is accomplished is simple. On the telephone shelf is a row of keys, five in all, marked thousands, hundreds, tens and units, the fifth being a release key. The subscriber who wishes to place himself in communication with some one of the other hundred or thousand subscribers taps out the desired number on the key-board, which automatically connects his wire with that of the person with whom he wishes to speak. Suppose for instance, that a subscriber wishes to communicate with No. 1123. He simply presses the key marked thousands once, the key marked hundreds once, the key marked tens twice, and finally the key marked units three times. His wire is then in electrical connection with that of the subscriber 1123, and he can ring his bell and converse with him in the same way and with us much ease if he had been wrangling with central for five or ten minutes. The whole mechanism of this, the Strowger, patent takes up a space of only 6x4x4 inches. The apparatus is placed in the central exchange and takes the place of the ordinary telephone girl. As for the subscriber's end of the line, there is nothing more than the ordinary telephone with a row of keys upon its shelf ; the mechanism at the exchange consists chiefly of a circular disc constructed of hard rubber or any other suitable non-conducting material, and this is the central feature of the machine. This disc is provided with perforations in circular rows of 100 each, these rows being about one-twentieth of an inch apart. Through these perforations extend the wire connections to the main line wires, so that the wire of every subscriber in the exchange comes to this instrument, and passes up through one of the perforations, ending in a good metallic contact slightly raised above the face of the disc. If, now, a moving arm or needle can automatically be made to make contact with any one of these points at will, it is evident that a telephone circuit can be completed and the object of the invention attained.

This is accomplished in the following manner :—A circuit-closing arm is made in parts, of which one is a rod. Within the circuit-closing sleeve is closely fitted a circuit-closing needle held in such a manner as to be in perfect electrical contact with the wire terminal by a spring. A rod is located along the axis of the cylinder and is free to rotate and move longitudinally ;

the lower end of this rod is sleeved
upper portion of the rachet rod. Th
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ing the ratchet teeth continuously towa
The rachet rod is provided outside of the
iently below it with a series of ratchet teeth
the rods are moved longitudinally. Two whee
the rods extend with a feather and groove connec
in contact with the ratchet teeth and levers, having
in their ends. Each lever has a vibratory moven
oscillated by the alternate energizing and de-energiz
electro-magnet, thereby imparting motion to its adjacent
teeth, and consequently the circuit closing needle. Each pressure of the push button at the exchange made at the will of the operator, causes, through the channels thus described, the circuit closing needle to move from row to row and from wire to wire, it being understood that both ends of the wire are grounded or connected with a return tap, and also that a battery is used to generate the current. This battery is located at the sub-station between the keys and the ground.

Each perforation of the cylinder is numbered with respect to an initial or starting point on the cylinder. When any conversation is ended the person hangs up his ear phone and presses the release key. This causes the magnets to be energized, attracting the armatures, thereby withdrawing the several pawls from their engagement with the ratchet teeth and allowing the circuit closer to fall and return to its initial point.

The subscriber is never isolated from the exchange. Suppose that two persons are in communication with each other and a third wishes to speak with the first. He can tap the number and make sufficient connection to ring his bell and call his attention to the fact that some one wishes to speak to him, so that the first subscriber can then at will release his instrument from the one with which he is in connection and connect with the third man, or he can continue his own conversation until finished, when upon pressing the release key, he will find himself in communication with the third person. The outside party, however, cannot either speak with the other party or listen to any of the conversation, he can only obtain sufficient connection to ring his bell.

Mr. Linnell claims that there can be no errors in the call, for an arrangement is provided on the instrument of every subscriber so that the number which he calls up is automatically registered on the front of his telephone. If a subscriber calls up No. 100 he sees 100 in plain figures on the face of his instrument, and there can be no question as to whether he is in connection with the right person.

A FEW POINTS ON UNPACKING AND ERECTING.

In unpacking machines and lamps, be very careful, says the *Scientific Machinist*, that packages are never dropped or jarred in any way.

Use special care to avoid dropping anything on to the lamp rods or arc lamps.

Never lay an arc lamp on its side, but set it up in some secure place.

After taking lamps out of boxes, remove the packing blocks, and see that all parts are in proper position and working freely.

In unboxing the dynamo, do not attempt to remove it from the box after simply taking off the cover ; but, instead, knock the entire box apart, leaving the machine standing on the bottom piece only. If the armature is shipped in a separate box from the balance of the machine, it will, in most cases, be necessary to use a hoist for the purpose of placing it in position, and great care should be used to avoid scraping or cutting of the shaft wires, or armature bobbins, in dropping the armature into place. Look the machine over thoroughly, and see that everything is in place and all screws tight. Secure the pulley firmly on the shaft.

It is a good plan to run a dynamo idle for a day, or even longer, if possible, following this with several hours' run with only a light load. This load should only be sufficiently heavy to warm up the fields and armature, so as to dry them out thoroughly in case they have become damp during transportation. A little care of this kind before putting the machine into regular service, will avoid trouble at a later stage of the proceedings.

It is very important to locate the machine in a dry place, and

[illegible] operating a number of lighting machines, it may not be necessary to run all of the dynamos for exactly the same length of time. Under such circumstances, a clutch pulley must be provided on the main shaft, which will permit throwing on or off the dynamo which it drives, as such dynamo may be needed or dispensed with.

A light double belt is the most desirable for lighting work. It should never be less than 30 feet long, and should be very pliable. If the belt is new and stiff, it can be softened up by applying neat's foot oil, or belt oil, on the outside.

THE MONTREAL LIGHTING CONTRACT.

Following are the terms upon which a committee of the Montreal City Council has recommended the renewal of the city lighting contract with the Royal Electric Co. : "That the contract for lighting the city of Montreal by electricity be awarded to the Royal Electric Company for a period of ten years from the first of January, 1894, at the following prices : For the first five years at 34 cents per lamp per night, equal to $124 per year; for the following three years at 33 cents per lamp per night, equal to $120 per year ; for the remainder of the term, two years, at 32 cents per lamp per night, equal to $116 per year ; each lamp to be of 2,000 nominal candle power." The present contract is $146 per light, and has one more year to run, but in consideration of a renewal the company agrees to reduce the price for the remaining year to $124 or a total of about $22,000, which would make an average of $110.35 per light for the whole term. The company under its present charter has an absolute right to maintain its poles in the streets, but it makes the following concessions : "Should the city at any time during the continuance of the present contract construct conduits for the placing underground of all electrical wires for whatever purposes they may be used, and cause all such electrical wires to be placed in said conduits, the Royal Electric Company shall make use of such conduits for its wires on such terms as may be mutually agreed upon, provided, however, the expense to the company for supplying electric light to the city or to its inhabitants be not thereby made more onerous than if they were to continue to use poles for the purpose ; and the company will then remove their poles from the streets, wherein such conduits are constructed without indemnity."

The following are the officers of the Canadian General Electric Co. :— President, W. R. Brock ; first vice-president, H. P. Dwight ; second vice-president and general manager, Frederic Nicholls ; assistant general manager, M. D. Barr ; comptroller, Walter S. Andrews ; chief engineer, W. M. Rutherford ; assistant engineer, H. T. Hartman ; purchasing agent, Geo. W. Watts ; superintendent Peterboro factory, William S. Andrews ; superintendent Hamilton factory, C. S. Stilwell.

I have an idea which, though not new to some, may be of use to others. It is just a little wrinkle in babbitting a journal box. When lining up a shaft, put a small piece of pine wood in the bottom of the box, in length about 1½ or 2 inches less than that of the box, and in width ⅝ to 1½ inches, according to the size of the box. Equalize it in the bottom from each end, let the shaft lie on it, and pour. After you have scraped out the box, remove the piece of pine and substitute some woollen cloth saturated with oil. This prevents the oil from dripping, and not only insures a more positive lubrication of the journal, but also is clean and requires less oil than other journals. · No patent is infringed.

A coating of pulverized chalk is excellent for preventing the packing sticking. A paste of graphite, plumbago, or black lead, as it is variously called, is most excellent. It is the finely pulverized product that is used, and the paste is made with water or some oil, having no gum as kerosene or lard oil or glycerine. Some old-time boilers used to have a steam dome surrounded by a cast iron safety-valve, from which steam is led to the engine. The valve is usually, in such cases, fastened to the dome with cap screws, holes for the same being drilled therein and tapped—the flange of the valve and dome being made steam tight by a rubber gasket between. If the rubber is objectionable, and the iron is wanted to join, a rough joint may be made tight and durable by putting between a cement made of boiled linseed oil with two parts litharge and one part each of fine sand and air-slacked lime mixed to a paste. It dries rapidly and should be screwed down before too stift. This cement is equally applicable to joints below the water line.

OFFICE: CONFEDERATION LIFE BUILDING,
Corner Yonge and Richmond Streets,
TORONTO, - - CANADA.
64 TEMPLE BUILDING, MONTREAL.

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EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

THE "CANADIAN ELECTRICAL NEWS" HAS BEEN APPOINTED THE OFFICIAL PAPER OF THE CANADIAN ELECTRICAL ASSOCIATION.

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GUELPH BRANCH NO. 6.—Meets every 1st and 3rd Saturday at 7:30 p.m. J. A. Angell, President; C. Jorden, Secretary.

...t the Toronto waterworks had a
...ays ago. A steel crank pin broke
...rough the back end of the large steam
... the daily papers it was estimated that
...00,000 lbs. to the square inch on the piston
... The pressure was certainly more than the
..., but if there had been even the half of the al-
...there would not have been much of the engine
...in which broke was five inches in diameter and the
...presented a rather brittle appearance.

...ERY strong protest is being made by electrical manufacturers and the electrical journals of the United States against the rule adopted by the Commissioners of the World's Fair to close the gates at 7 p.m. The Commissioners have explained that the rule was adopted not with the purpose that it should be enforced every evening, but to place in the hands of the Commissioners the power to regulate the hours of closing. This does not satisfy the electrical people who have gone to great expense in preparing exhibits in the belief that the Fair would be open every evening. It is probable that the protestations will be so vigorous as to compel the Commissioners to alter their decision.

THE Montreal City Council is considering the question of the renewal of the lighting franchise, and has appointed a committee to confer with the Royal Electric Light Co. on the subject. This action on the part of the Council has aroused the criticism of the citizens, on the ground that a clause in the present contract provides that the contract shall not be renewed, except after tenders have been called for at least one year before its expiry. There are several other companies desirous of tendering for the franchise, and they are talking of applying for an injunction to restrain the Council from renewing the contract with the Royal Co. without publicly inviting tenders for the same. There is every indication that proceedings of a lively character will precede the settlement of the matter. Since the above was written, the Committee has recommended to the Council a basis of renewal with the Royal Electric Company.

A HIGH spirited electric car in Montreal resolved the other day to get out of the rut. It consequently forsook the rails and made a bee-line for the sidewalk. A lady sitting in an upper window saw it coming and promptly went into hysterics. Fortunately for everybody concerned, the runaway didn't succeed in dodging an electric light pole that stood in its way. The pole was snapped off as though it had been a twig, and the force of the concussion landed the motorman and one of the company's experts over the dashboard. The car was but little injured. Although to all appearances it has become resigned to again pursue the even tenor of its way, a watch should be kept on its movements, as, like a horse who has once felt the pleasure of getting free from control, it is likely some day to want to repeat the experience.

THE chief engineer at the Badger Electric Light Co.'s works, Milwaukee, was killed a few days ago. It appears he was alone in the engine room when the steam pipe burst and he died from the effects of scalding. He had the steam shut off and was repairing the engine, at about half-past four in the afternoon. Some other employee turned the steam on, with the result that the pipe burst and the chief lost his life. Leaky valves and thoughtlessness are responsible for the greater number of such accidents as this. A leaky valve when shut allows a little steam to pass; this condenses and water accumulates in the pipe beyond the valve. A thoughtless attendant will open the steam valve without first draining off the water, or he will open it up quickly instead of slowly, and the sudden rush of high pressure steam into the pipe and coming in contact with the water will produce water hammering enough to rupture the strongest pipe.

CHIMNEY draught when defective has been helped in many ways—sometimes by a fan forcing air under the grates, or by a steam blast forcing air under the grate or over the fire. In locomotives the draught is induced by exhaust steam forced through a jet at base of the smoke pipe. Korting Bros. make an apparatus which is placed in bottom of chimney and by means of a straight jet induces a current of air. A Chicago firm is at pres-

ent trying the experiment of an exhaust fan placed on top of the chimney. If it will work at the top of the chimney, why not have it at the bottom, and save the trouble of carrying the power up so high and having to send oil up to the bearings? The chief difficulties in using an exhaust fan for promotion of a draught are the high temperature of the gases passing through the fan and the necessity for getting rid of the gases. If the fan could be got to run notwithstanding the high temperature of its bearings it might be a good plan to make the discharge go down into the sewers. Enough deadly gas might be sent down and hot enough to kill all the typhoid fever and diphtheria that are said to dwell in the sewer.

As we were going to press with our last issue we were the recipients of a letter from the Brantford Electric Light Company complaining of an editorial in a previous issue of the NEWS commenting on the low prices, etc., obtained in a near-by city on the renewal of their electric lighting contract. As we did not mention any names in connection with the article complained of nor indulge in any personalities whatever, we must decline entering any further into the matter, further than to say that we had no wish to tread on anybody's toes, but only to point out to our readers the necessity of using their utmost endeavors at all times to give their patrons the best of service, and thereby secure at least fair prices for that which they have for sale.

THE Council of Toronto Junction, having had enough experience with municipal electric lighting, have sold their plant, together with a nineteen years' franchise, to the Toronto Incandescent Electric Light Co. for the sum of $26,900, on condition that the purchasers will operate the plant in Toronto Junction during the term of the franchise. The City Council of London, Ont., scorning to be influenced by the experience of a smaller town, is about to insist upon the privilege of purchasing in the dearest market a stock of experience of its own. A by-law will therefore be submitted for the approval of the ratepayers to authorize the appropriation of $60,000 for the purchase of an electric light plant. Possibly, as in the case of Brantford, the citizens will knock the scheme in the head. There is likewise the possibility, if not the probability, that this announced intention of the Council is simply designed to be used as a lever with which to bring pressure to bear to induce the Company, which is at present furnishing light to the city to lower its prices. In any case, we hope to see the scheme fail.

THE cold weather compels attention to the heating apparatus. Now the landlord complains of the large amount of coal required at the boiler, while the tenants complain of the small amount of heat at the radiator. The best designed and most perfectly constructed apparatus will not heat the building unless it be attended to. Coal is put in the furnace to be burned, but when it is put on top of the bridge wall or on the dead plate just inside the furnace door its burning will not do much good. The making of fire under a steam heating boiler requires experience and skill. The method of employing the man who will shovel the most coal for the least money is a mistaken one. It gives satisfaction to none of those concerned, unless the coal dealer. It will pay owners of steam heating plants to employ competent men and pay them according to results. As a rule it will be found cheaper to keep a large building warm all night as well as all day, than to let it cool down at night, and a skillful fireman can arrange his fire so that for six or eight hours after he has left it the boiler will still make vapor enough to keep the radiator warm.

THIS is the agreement which the city of Kingston requires any company to sign in return for the privilege of supplying an electric street car service :—"The company to pay to the city annually the sum of $200 per mile for single track and $300 per mile for double track, for rent and keeping roadbed in repair, also the following percentages on gross receipts, viz.: When the total gross receipts reach $15,000 per annum three per cent. on the total gross receipts till they reach $20,000 per annum, and when they reach $20,000 per annum four per cent. on the total gross receipts till they reach $30,000 per annum, and when they reach $30,000 per annum and upwards, six per cent. on the total gross receipts." An alderman after a perusal of these conditions is said to have remarked that no one outside an asylum could be found willing to make an offer on such a basis. The present street car company claim to have the right under their charter to a perpetual use of the streets and refuse to change to electricity unless this right is recognized. On the other hand the city authorities contend that the law provides that a charter for electric street cars cannot extend beyond twenty years unless special legislation is obtained, in which case the period may be extended for another ten years only. No doubt a demand on the part of the citizens to be given the advantages of electric transit will before long force a settlement of the existing difficulties.

THE novel sight of a brigade of axe men engaged in chopping down poles erected by the Street Railway Company has lately been witnessed on the streets of Toronto. The City Engineer's action in ordering this to be done seems justifiable. The agreement which the Street Railway Company entered into with the city provides that the character of the construction and equipment of the system shall be subject to the approval of the City Engineer. The Company has lately acted as though its intention was to evade as far as possible compliance with this agreement. It has erected poles which would disgrace the streets of a backwoods village, and has accentuated their native ugliness by painting them a variety of colors. In many cases a brilliant red is the prevailing hue. Is it a matter of any wonder that the citizens of so respectable a city should object to the Company "painting the town red"? There seems to be manifest in the Company's dealings with the city as well as with private corporations and individuals a disregard for the rights of others as well as its own promises. To get possession of what it wants now under promise of remedying in the future what is below the standard, seems to be the policy pursued. Whatever the other party to the contract may do, the Company appears to have always in mind the fact that "possession is nine points of the law." If the company intends to continue to own and operate the road, it is making a huge mistake by antagonizing public favor, and even if, as is asserted, its intention is to dispose of the franchise, the fact of its being at loggerheads with everybody must tend to lower the value of the privilege in the eyes of intending purchasers. We refer to this matter because such conduct is calculated to increase the prejudice against which promoters of electric railways have had to contend, and thus to retard further development.

ONE important point in the operation of incandescent electric light from a central station, and which is a vital one when the cost of operating is taken into consideration, is that due care and diligence should be exercised at all times to see that the lamps on the circuit are never allowed to be strained with higher voltage than they are made to carry. We feel sure that we are right when we make the assertion that an increase of 5 per cent. in the voltage maintained for say 100 hours in the life of a lamp will shorten its life fully 25 per cent., which means that the lamp account is 25 per cent. more than it would have been had the lights been kept at or below their normal voltage. We are aware that it is sometimes a difficult matter to so arrange things that this can be done, but there can be no question that it will pay well to see that it is so arranged. This is a matter that is perhaps more difficult to adjust on alternating methods of supply than on straight current machines, as they are generally compound wound, and take care of variations in load with only an occasional hand adjustment, which is necessary almost continually in the general run of alternating dynamos at present in use in this country, while the load is fluctuating either in one or the other direction. There are alternating dynamos being manufactured for which the claim is made that they are self regulators in every sense of the word, but their use in Canada has been very limited owing to the fact that it was necessary to import them and pay heavy duties, bringing the price to such a pitch that it almost prohibited their use here. In this connection we are credibly informed that this state of affairs is about ended, and that at least two of the large manufacturing electrical companies in the Dominion are at present getting out plans and patterns for self-regulating alternating dynamos with compound windings, in the use of which potential wires and compensating devices will be things of the past.

THE ELECTRICAL NEWS completes with this number its second year of existence. An index to the contents of this volume accompanies the present number. A perusal of it should satisfy every subscriber that he has had value for the price of subscription. Indeed, some of our most intelligent subscribers have expressed the opinion that in some cases a single article was in itself worth to them the price of a year's subscription. The co-operation of every reader is asked towards making the paper increasingly valuable, and thanks are extended to those who have in any way assisted its progress in the past. To all the wish is extended for a Merry Christmas and prosperous New Year.

IT isn't often of late that the tallow dip and coal oil lamp get a chance to demonstrate their usefulness in competition with the incandescent electric light. Such an opportunity came to them, however, in Toronto a few nights ago, when by reason of the fusing of a safety catch in the junction box of an underground feeder, the incandescent lamps went out. In many of the business buildings gas has been entirely dispensed with, and when darkness settled down upon them, the lighting methods of our ancestors suddenly regained a brief popularity, while at the same time serving to impress the public mind with a greater appreciation of the value of the modern illuminant.

IN supplying power from a central station for the operation of a number of small motors, it is of the utmost importance to both those supplied as well as to those supplying it, that a constant pressure or E. M. F. be maintained on the mains during all the time that it is in operation. A greater fluctuation than 5 per cent. should under no circumstances be allowed by the attendant in charge of the generating plant. The principal reason is that a motor running at or about full load at a certain speed will feel a greater drop than this very sensibly, and will lose a number of its revolutions, particularly if the drop is as great as 10 per cent. So great would be the difference in the number of revolutions, particularly on very fast running small motors, that it would cause an appreciable difference in the amount of work being turned out by the various machines under operation, meaning of course a loss to the power customer, which if kept up for any length of time, would in all probability cause him to condemn electric power or perhaps throw it out entirely. True, the fluctuations in load on a generator, that, among other things is operating a few passenger elevators, is sometimes so great that it precludes anything like fine governing either by hand or automatically, but the fact remains nevertheless that it will pay best to keep up as near a constant pressure as possible. These remarks do not apply to generators operating street railways, for in their case there is so great a fluctuation in the load at times as to make it almost an impossibility to maintain a constant and steady E. M. F., nor is it essentially necessary to do so, owing to the fact that a regular speed is not required, it being seldom necessary for the motor man to turn out all of the resistance of the rheostat to get his car to travel its set speed, and a drop in the E. M. F. can easily be compensated for by turning in a little more current, it being a combination of the E. M. F. and amperes (or watts) that does the work.

WE have quite recently seen tested a one inch by half inch oval carbon for all night single rod lamps, and to judge from this test, they are unquestionably the right thing in the right place. The test on a 10 ampere current showed a life of 10 to 20 hours for each pair (one twelve and one seven inch), plain black ones being used, without any coating of copper at that. In fact a test was also made at the same time of a coppered one of the same size, but owing to the carbon being consumed without breaking down or fusing the copper, it was necessary to occasionally knock off the long metal horns which formed at the extreme outside width of the carbon. In using this style of carbon it is necessary in order to obtain the best results, to set them in the lamp at right angles to one another, and also that means be provided in the lamp to keep them in this position as they feed down. This is not an easy matter to do in the ordinary clutch lamp, perhaps, but in a clockwork lamp, with rack rods, no other device is necessary than to fit them with holders suitable to the shape of the carbons. Such carbons are actually money savers to the company using them, their first cost being considerably less than would be that of enough 7/16 carbons to last the same length of time. Again, there is this consideration, that a plant requiring the lamps trimmed every day, say for six months in the year, would only need them trimmed or carboned every other day for the other six months. Thus, one trimmer would take the place of two for that length of time, a decided saving as all will admit who have weekly wages to pay to half a dozen or more trimmers, and who find it uphill work to make the plant even show a semblance of paying any profit to those who have their money invested in it. The argument may be used that it is necessary that every lamp should be looked after in some way or other every day, to see that the rods are clean, etc., but this is not absolutely necessary where a black carbon is used ; they cannot pass by or become locked if used as shown above, nor can there be any reason whatever advanced to show that this method of all night lighting is not a change in the right direction and a money saver for the company. Another point, is that the dynamo may flash around the commutator without the least fear that there will be any of the carbons pass by or lock, which is decidedly not the case where a double rod lamp and 7/16 carbons are used.

C. A. S. E. No. 6, GUELPH.

GUELPH, NOV. 21, 1892.

Editor ELECTRICAL NEWS.

A regular meeting of No. 6, C. A. S. E., recently organized here, was held on Saturday evening last. Two applications for membership were received. Every member was present, making the total attendance 16.

The President, Mr. John A. Angell, gave a lengthy and practical lecture relating to boilers, the common slide valve engine, steam pumps, etc., and questioned the brethren on these and other subjects pertaining to steam engineering.

So pleased was everyone present with the lecture, that a resolution was passed requesting the President to repeat it at next meeting.

As we are but new beginners, we would feel greatly obliged for any information or assistance of any kind which our more experienced brethren in the Association may feel disposed to give us.

Yours truly,

C. J. JORDAN, Rec. Sec.

PERSONALS.

We have been favored with a copy of a Newport paper containing full particulars of the wedding of Mr. John Carroll of the Eugene Phillips Electrical Works, Montreal, and Miss Emily Selina Ryan, of Newport. Miss Sadie Carry was the maid of honor, and Mr. Andrew J. Carroll the best man. The ushers were Messrs. Sanford Gladding, Dr. Wm. Carry, Wm. Christie, of Montreal, A. J. Carroll and H. T. Rooney. The residence of the bride's mother, where the ceremony and wedding festivities took place, was tastefully decorated for the occasion. A large number of the friends of the contracting parties were present. Mr. and Mrs. Carroll left Newport the same evening for New York, and returned a few days ago, by way of Toronto, to their future home in Montreal.

In a recently published list of men of wealth in Montreal appears the name of Mr. Charles R. Hosmer, director of the C. P. R. telegraph system. The following particulars of Mr. Hosmer's career, from the Kingston *Whig*, will be of interest to our readers:—"He was an operator in the service of the Montreal Telegraph company when the Dominion Telegraph company was projected, and he had the ambition to advance and become manager. The new business prospered under him, and it was not long ere he was translated to a higher sphere, to the position of superintendent of a division, in which he showed much ability and qualified for the responsibilities of a still higher position that which he holds now as director of the Canadian Pacific railway's telegraph system. He is one of the best known telegraph men in America and in connection with the Commercial cable he is known across the Atlantic also. It may be said that for him there were grand openings presented to but few, but how many are there who do not take advantage of the opportunities they have had and so give point to the old law that 'nothing venture nothing have ?' Granted that Mr. Hosmer was fortunate in his associations, fortunate in his choice of situation and lucky in his chances, he had the tact and the wisdom to carry himself right, and he shaped his purposes and plans to suit the emergencies of life. Above all he has not lost his head ; success and prosperity have not interfered with his usefulness, and he is as active and enterprising to-day as when he set out, only a few years ago, to build up a name and a reputation of which he has reason to be proud. His record should be an inspiration to all young men. It points to what can be done by work and courage and laudable ambition."

Some of the officials of the city of Toronto profess to have discovered that the Toronto Electric Light Co.'s building stands partially on the line of a public street. The company deny that such is the case.

SPARKS.

The Council of the town of Port Hope has appointed a committee to ascertain the cost of an electric light plant.

An electric tramway, to connect the town of Rat Portage with the towns of Norman and Keewatin, is projected and will probably be built next summer.

It is stated that the construction of an electric street railway in Halifax has been definitely decided upon, and that the work will commence in the spring.

Mr. J. Culverwell, lately representing the Edison General Electric Co. at Montreal, has been appointed general agent of the Automatic Telephone Co. of Canada.

The experiment is to be tried at Ottawa, of drying lumber by means of electricity. The apparatus for that purpose is in course of construction by Mr. Parr, of that city.

Mr. Maxwell, of the Portland office of the General Electric Co. has been appointed as manager of the British Columbia division, to succeed Mr. J. S. Anderson, resigned.

A resolution was recently passed by the Board of Works of the City of Hamilton, requiring the Hamilton Electric Light and Power Co. to verify by declaration all their accounts.

A by-law authorizing the issue of debentures to the amount of $14,000 for the purchase of an electric light plant, was carried on October 24th, by vote of the ratepayers of the town of Niagara, Ont.

A company recently organized has applied to the Council of the city of Quebec for permission to build an elevated electric street railway in that city. They also ask exemption from taxation for 30 years.

Stock to the amount of $60,000 has been subscribed for the purpose of constructing an electric railway to connect the towns of Watford, Arkona and Thedford, Ont. The undertaking will be proceeded with at once.

As a result of a recent meeting of the citizens of Lethbridge, N. W. T., it was decided to organize a local electric and power company with a capital of $25,000. A committee of five was appointed to open a stock book.

The annual report of the Montreal Street Railway shows there has been an increase of 50 per cent. in the passenger traffic during the last three months. The year's business netted a profit of $93,880.21, as against $60,361.71 the previous year.

The Ottawa Board of Trade has appointed a deputation to wait upon the Dominion Government, to urge that action be taken in conjunction with the Imperial authorities, to push forward the scheme for the construction of a cable between Canada and Australia.

The electric cars on the streets of Victoria, B. C., are said to be much larger than those in use in Eastern cities, being capable of holding nearly 100 passengers. They also run at a much higher rate of speed. The road connecting Vancouver and New Westminster covers the distance between the two cities, 14 miles, in 50 minutes.

The Ottawa Electric Street Railway Co. has applied to the Ontario Government to be given three small islands in the Ottawa River, a short distance from the city. Should the request be granted, the intention of the Company is to extend its tracks to the river banks, construct a bridge from the mainland to the islands and establish a summer resort.

A convention of the railway telegraphers from all parts of the continent will be held in the City of Toronto, on the 15th of May next. It is expected that 300 to 500 delegates will be present. The membership of the Order of Railway Telegraphers numbers about 30,000. The Order has on hand a protective fund amounting to over $40,000 and a rest fund of $30,000.

The Legislature of British Columbia, at its next session, will be asked to grant incorporation to the Kalso City Electric Light and Power Co. Ltd. The Company propose to erect and operate electric works in and about Kalso City, which is situated in the West Kootenay district. The promoters of the Company are S. H. Green, F. E. Coy and B. H. Lee.

Action has been entered by the Dominion Government in the Exchequer Court, to recover from the town of Port Arthur the sum of $1,596, duty on 266 tons of steel rails, used in the construction of the electric street railway of that place. It was decided some time ago that rails for electric street railways should be classed as tramway rails and consequently should be subject to duty.

The Hamilton City Council has refused the request of the Hamilton, Guelph and Beamsville Electric Railway Co, for a bonus of $50,000 to aid the company in the construction of its line. It is understood that this decision will also apply to the proposed Radial Electric Railway Co., and the Guelph and Waterdown Company. The promoters of the Beamsville road, when asking for the bonus, stated that the road would not be constructed without it.

The attorney for the Toronto Street Railway Co., while in Detroit recently, stated that the company were perfectly satisfied with the arrangements with the city of Toronto. The gross receipts last year were upwards of $800,000 and the receipts for next year are expected to exceed $1,000,000. Last year the company paid 8 per cent. and $800 per mile for single track to the city. Should the receipts next year exceed $1,000,000 the company will have to pay 10 per cent. to the city.

A citizen of Toronto recently brought action for damages against the Bell Telephone Co. for having cut branches off shade trees overhanging the street in front of his premises. The Company alleged that the branches interfered with the use of the wires of the telephone system which they had contracted with the city to maintain. The Court of Appeal held that the plaintiff had no interest in or title to the trees growing in the street sufficient to enable him to complain of the cutting. The Court likewise held that as the branches overhanging the street, growing within the plaintiff's grounds, were not a nuisance and in no way interfered with the use of the highway, the defendants had no right to cut them.

Some time ago the township of Etobicoke passed a by-law granting a bonus of $20,000 to aid the construction of the Toronto and Mimico electric railway. The by-law under which the bonus was granted provided for the completion of the road by the 31st October, 1891. The road was not completed by that date, consequently the object of the by-law was lost by default. It is said, however, that the promoters of the railway are rather pleased than otherwise at the way things have turned out, as an appeal had been taken from the decision of the court sustaining the by-law, by parties opposed to the payment of the bonus. Under present circumstances the company will escape the costs incident to this appeal, amounting to about $759, and will shortly have the by-law again submitted and expect to succeed in having it carried.

The conditions of the agreement which the city of London has just made for the construction of an electric street railway provide that the work of building the track must be begun between Nov. 15, 1892, and March 15, 1893. Seven miles of the railway must be completed, and the electric cars running thereon within two years. At the end of 20 years the city may, after six months' notice, assume the ownership of the railway on payment of its value, to be determined by arbitration. The company will pay yearly to the city $100 per mile of single track and $200 per mile of double track, if the gross receipts of the railway are $60,000 a year. The company will also pay on all gross receipts under $100,000, 5%; between $100,000 and $125,000, 5½%; between $125,000 and $150,000, 6%; between $150,000 and $175,000, 6½%; between $175,000 and $200,000, 7%; over $200,000, 8%.

One of the large expenses of a street railway electric power plant is that arising from the burning out of the armatures of motors, which results sooner or later, with almost every machine in service. To start a car requires, of course, the expenditure of more electrical energy than is necessary to keep one in motion. This excess of electrical energy, when applied for the purpose of starting a car, has the effect of severely shocking the armature, which results in burning it out. The same effect is shown in stopping a car, as the sudden check in current, which must result, shocks and burns the coil on the armature. The force thus turned on for starting varies greatly according to circumstances, and it might not be precisely the same at any two times of the many which occur in a completed trip. The inertia, also, which is to be overcome by the motor, varies even more often according to the load, grade and state of soil; while the discretion of the driver, in turning on current in proportion to his load, can never be counted on with any degree of certainty. A mechanical regulating clutch has been brought out in Philadelphia, by which the machinery is started so gradually that only one-fourth of the force is permitted to enter the motor at once which would enter without the application of the clutch; and, therefore, the burning out of an armature is an absolute impossibility. After a car is in motion, it is claimed it can be stopped and started without interfering with the electrical energy or increasing it in the slightest degree. The motor runs continuously, but only works when the clutch is thrown in contact.

NOTES.

When a hand-hole plate or flange joint is to be packed it is well to have in mind the fact that it will require re-packing sometime, and do the work with a due regard for the future. It is the custom of many to cover plate surfaces and both sides of the gasket with a sticky mixture of white or red lead and oil, the object being to fill all the cavities that may be in the iron that is not touched by the gasket, and in hardening prevent a leak. The lead well does its work, but when from any reason it becomes necessary to break the joint and make it up anew, the conviction is forced upon the mind that while white or red lead makes a staunch joint it also makes a great deal of work in cleaning it for the new, as the lead either dried or burned fast, is very difficult to remove, requiring a scraper and a considerable amount of muscular energy. It is very seldom that such a paste is required—it seems advisable with hemp—and it is usually more a desideratum to have the packing remove easily than to burn fast.

We dropped into the engine room of one who is glad to learn, says the *Boston Journal of Commerce*. He was having trouble with an inspirator, and was the more troubled because the water line was fast disappearing, and the "blamed thing was broken and wouldn't start." It was no consolation that others had trouble with an inspirator before, and the same trouble, in fact, which was hardly the fault of the inspirator. The inspirator was fed from a tank overhead. The valve on the inspirator leaked, from a bit of grit getting under its seat, so that the steam entering through the suction-pipe into the tank rapidly converted the water therein to such a temperature that condensation was rather out of the question. The engineer did not notice how hot the water was in his tank, but started and restarted the inspirator as often as it broke. All we could suggest was that he close the valve from the suction-pipe of the inspirator to the tank, so no more steam could enter, and hold the water-valve in the tank open until enough water had run in to cool the whole down to a temperature where it would draw, and in future keep steam out of the tank. In this way the trouble was overcome, and with cool water it worked nicely.

A CONTRIBUTION TO THE THEORY OF THE TELEPHONE.

In the development of the Bell receiver, it was found in practice that a louder effect could be obtained by employing a magnetized core instead of a plain soft iron core. This appears to be at variance with ordinary experience, it being generally supposed that for a maximum effect, the core in electro-magnets should be of soft iron.

An explanation of this, which seems to be commonly received, attributes the improved results to the diaphragm of the receiver being kept permanently in a taut condition, and being thus, for some reason, in a better condition for taking up the vibrations than when left relaxed. However, no very clear ideas upon the subject seem to be current.

For some time past Dr. F. T. Trouton has been experimenting, with the object of clearing up this point, the result of which is to almost entirely refer the improved effect, obtainable by permanently magnetizing the core of the telephone, to the fact that the mechanical force on the diaphragm or armature of the electro-magnet, is proportional to the square of magnetic force. He points out that the variations in the force of the diaphragm, and consequently its aptitude of variations, will depend on the permanent magnetization, as well as on its vibration produced by the currents passed through the telephone. Or to look

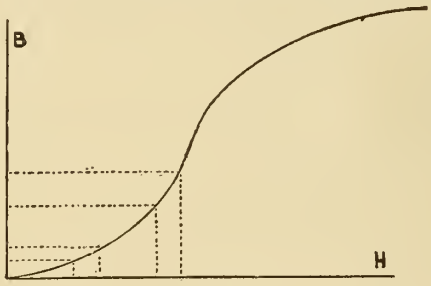


FIG. 1.

as it another way, it is important that, initially, the armature have strong magnetic poles ready to be acted on by this variation. (This would suggest magnetized steel diaphragms for louder effects.)

Another advantageous result arising from permanently magnetizing a soft iron core by the addition of a steel magnet, as in a common arrangement of the telephone, probably is, that the permeability of the soft iron is increased thereby; so that the magnetic force at the armature, arising from the current, is greater than were the current to act on an initially unmagnetized core. This effect is probably always unimportant compared with the last.

The effect here alluded to may perhaps be better understood by reference to the well-known curves of magnetization (fig. 1), where it will be seen at once that equal small variations in the magnetic force produce effects in the magnetization dependent in amount on the initial position on the curve.

An apparatus which Dr. Trouton found convenient in his investigation is shown in fig. 2. It consisted of an ordinary tam-

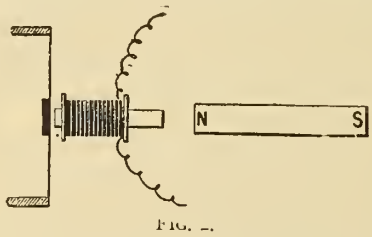


FIG. 2.

bourine, armed in the centre with a little piece of iron, which thus could be made to vibrate by an alternating current passed through an electro-magnet with a soft iron core, placed "telephone wise," close to the little piece of iron. The core could be permanently magnetized to the extent desired, either by a current passed through an additional coil wound on for the purpose, or by bringing up in a line with the core a permanent magnet to a variable distance.

With such an apparatus it is easy to show the gain in sound brought about by permanently magnetizing the core of the electro-magnet. For this purpose, an alternating current is employed of insufficient intensity to affect the diaphragm much; one then brings up the permanent magnet to the position shown in the figure, upon which the sound is found to be immensely improved. A similar result, of course, can be obtained by a permanent current sent around the additional coil.

To distinguish between the parts of this improved effect due, respectively, to the two cases mentioned above, one can either connect up the additional coil wound on the electro-magnet with an electro-dynamometer or with a telephone. If the improved action on bringing up the steel magnet were entirely due to the second cause (namely, the fact that then the same current is able to produce more lines of force in the iron than before), the deflection of the dynamometer, or the sound in the telephone, would increase in like proportion with the loudness of the tambourine. The experiment proves that though there is undoubtedly a slight increase in the number of lines of force, shown by a slight increase in the deflection of the dynamometer, the chief improvement is to be referred to the other cause.

Dr. Trouton made a similar experiment with the additional coil wound on the armature instead of on the core. This was effected by taking a rather thicker piece of iron than that which had been previously employed for the arming of the daiphragm of the tambourine. In connecting up a telephone with a coil, it could be arranged so as to have the sound from the telephone and from the tambourine, with the steel magnet removed, of equal intensity; then, on bringing up the magnet as before, the sound of the tambourine is found to be far and away louder than the telephone.

Lest it might be thought that the increased effect could be due to the diaphragm coming nearer to the electro-magnet, in consequence of the attraction arising from the permanent magnet, it may be mentioned that similar effects are produced on placing the magnet on the opposite side to that shown in the diagram. In this position, the diaphragm lies between the magnet and the electro-magnet, and consequently tends to be drawn *further* away from the magnet.

Dr. Trouton says that a somewhat curious effect is to be observed with this apparatus on employing an intermittent current instead of an alternating one. With an alternating current a continuous increase in sound is, of course, produced indifferently by either pole of the permanent magnet, as it is brought up from a distance to the position of contact with the core. One pole effects, as before, a continuous increase in the intensity of the sound as it is brought up from a distance to the position of contact with the core; but the other pole, at first, as it is brought up, steadily *diminishes* what small amount of sound the current alone may be capable of producing; reaching a minimum the sound still begins to increase, and continues doing so until the position of contact is arrived at. In this case the permanent magnet is opposed, (that is, lies in the opposite direction) to the magnetization produced in the soft iron by the intermittent current. The position of minimum sound evidently is that in which the average permanent magnetization resulting from the intermittent current is just neutralized by the permanent magnet. For, as we have seen already, a small change in the magnetizing force applied to an electro-magnet should produce least mechanical force on the armature under such circumstances.

In the current issue of the *Philosophical Magazine*, Dr. Trouton deals with this subject under the title "The Theory of the use of a Permanently Magnetized Core in the Telephone." Although we have made a very full abstract of this paper, our readers will find much more that is interesting in the original. Towards the end of it is an account of some rough experiments made by Dr. Trouton to obtain quantative results, and those obtained agree with the theory as well as could be expected.—London *Electrical Review*.

A section of the Alabama code authorizes the consolidation of manufacturing corporations. The Supreme Court of the State held, in the case of Beggs vs. Edison Electric Company, that electric light companies are manufacturing corporations within the meaning of this section. The court said: "When we take into consideration that the electricity now used and applied in the ordinary business of life is essentially the product of skill and labor, we can find no difficulty in reaching the conclusion that a corporation engaged in generating, storing, transmitting and selling such electricity, to be used for lighting purposes, is a manufacturing corporation. In reaching this conclusion we are not without precedent. The very point we have in hand was ably considered in the case of People vs. Wemple, 129 N. Y. 543. In that case the Court of Appeals of New York were unanimous in the opinion that the electric light company was a manufacturing corporation."

ELECTRICAL LESSONS FOR STUDENTS.

THE first question invariably asked by a student is: "*What is electricity?*" To this no more satisfactory answer can be given than to the questions, what is heat, light, gravity, etc.?

If electricity, light and heat are not the same, they are very closely related. The question with us should be not what is electricity, but how best to apply it.

As we know how to obtain and apply artificial light and heat, so also do we know in a measure how to obtain and apply artificially produced electricity.

The simplest and most direct way to generate electricity is by means of the voltaic cell or battery, but the method of generating electricity to operate devices coming more within the range of our lessons is by the dynamo machine.

A voltaic cell consists of two metallic plates of different metals, submerged in a solution which will very readily and rapidly attack one plate without affecting the other.

By connecting a wire to each of these electrodes and attaching the free ends of the wires to a galvanometer, the indicating needle thereof will instantly be deflected and show that a current of electricity is passing through it.

A *voltaic cell* is, then, an appliance for artificially producing electric energy from chemical action. The metal plates of the battery are called the *electrodes*, the one attacked being the *positive* and the one not attacked the *negative*.

The battery solution or exciting fluid is called the *electrolyte*. For powerful currents such as are required for light and power, the solution is composed of some of the acids diluted more or less with water. When the wires from the cell are joined together, through the galvanometer, it is said that the *circuit* is complete or closed, *i. e.*, that there is no break in the chain of conductors.

The *circuit* is said to be open when the chain is severed at any point throughout its entire length. Simply connecting together the battery wires without the galvanometer or other device in *circuit* would be called *short circuiting the battery*. The result of such short circuiting would result in the rapid destruction of the battery.

By the *opening* and *closing* of the electrical circuit by means of a suitable lever called a *key*, the telegraph operator transmits his message. A short depression of this key will indicate at the distant end of the telegraph line a *dot*, while a longer depression will indicate a *dash;* these dots and dashes are grouped together to represent the alphabet.

The galvanometer is an instrument for indicating the presence of electricity. It is to the electrician what the mariner's compass is to the sailor. The galvanometer, like most other electrical instruments, is exceedingly simple. It consists essentially of a freely suspended or pivoted *magnetic needle* around which is wound a number of convolutions of fine *insulated* wire. The deflection of the needle, with the same power, may be increased by increasing the number of convolutions of wire. Instruction for making a simple form of galvanometer will be given when the subject is reached.

The galvanometer is simply an instrument employed to show the presence of an electric current, or to show when electricity is passing through the circuit of which it forms a part.

The circuit is the path over which the current flows. The ordinary galvanometers are graduated simply in degrees, which by themselves have no actual value. The galvanometer in all its various forms consists of a coil of *insulated* wire having a magnetic needle freely pivoted or supported within, and so that



FIG. 1.

when a current passes through the wire it will have the greatest effect upon the needle. The best results are obtained when the coil and magnet are close, and when each convolution of the coil lies in a plane perpendicular to the needle.

The magnets of the class of galvanometers called *Detectors*, are pivoted in a vertical plane having one end made slightly heavier than the other, so that it hangs with the pointer perpendicular. A current passing through the hollow coil will cause the needle to be deflected to the right or left, according to the direction of the flow.

The principle of construction of the galvanometer may be understood better by reference to Fig. 1, in which N S represents the freely pivoted needle, and A B C the connectors to an insulated wire which surrounds it. When the two wires from a battery are conducted to A and B, the current will flow only through the upper wire and the magnetic needle will be deflected only slightly. On removing the battery wire from A and connecting it with B, and the other battery wire from B and connecting it with C, the current will flow through the lower wire only, and under like conditions the action on the needle will be the same, so that when the current passes in the same direction the action is the same through the upper or lower wire. On removing the battery wire from B and connecting it with C, the deflection of the needle will be considerably increased, as the wire below will exert a like influence on the needle and in the same direction as the wire above, and the deflection of the needle will thereby be increased; and so on, will the deflection of the needle be increased for each and every additional turn of the wire forming the hollow coil which surrounds it.

By connecting one battery wire to both A and C, and the other battery wire to B, we will, so long as the wire above and below the needle are equal, obtain no deflection. The reason for this is that the current is divided equally between the two wires and the influence of one wire on the needle is counteracted by the influence of the other, which is reversed. Galvanometers constructed on this principle are called differential. By increasing, decreasing, or in any way altering the resistance of one of the wires only, we again get a deflection. This fact is taken advantage of and will be fully explained when dealing with the construction of the apparatus for testing.

The needle tends, at all times, on the passage of the electric current through the wire, to set itself at right angles to the wire, and this it does in proportion to the number of turns of the wire and the strength of the current.

If we reverse the position of the battery wires by connecting the one removed from A to C and the one removed from C to A, we shall also reverse the direction of the deflection of the needle, and this action will be due to the change made in the direction of the passage of the current.

The current in passing through the hollow coil of the wire, produces in the space surrounding it a *magnetic field*. It is this temporary magnetic field which acts upon the *permanently* magnetic needle and causes it to be deflected.

From the above you have learned that a current passing through a fixed wire which is supported parallel to a magnetic needle, will cause the needle to be deflected or to take up a position at right angles thereto, in proportion to the strength of the current flowing, and that by increasing the number of wires or convolutions of the insulated wire around a freely pivoted magnetic needle, it will, with the same current, likewise increase the deflection of the needle.

We have learned also that the electric current, as it flows through the insulated wire, causes each turn, half turn or complete convolution, to act for the time being as though it were itself a magnet, and that the space around the wire thus influenced is called the magnetic field. Further, that when a freely suspended magnetic needle is at rest it will have its ends directed to the North and South pole of the globe, and that when thus influenced it is said that the action is due to the earth's magnetism.

In all horizontal forms of galvanometers, before the current is allowed to pass for taking a reading, it is necessary to place the instrument so that the needle comes to rest at zero under the influence of the earth's magnetism. The deflection of the needle caused by the passage of the current will determine its strength.

The word *poles* is, in general, applied to the ends of magnets, to the ends of batteries, to the terminals or ends of the armatures on dynamo machines, electric motors, etc.

It is a fact no doubt well known to all our readers that one *pole* of a magnet will repel the like *pole* of another magnet, and that unlike poles will attract each other: and that the expression *poles* is generally understood as meaning the ends of magnets, batteries, etc.

The poles of an artificial magnet are generally designed to be

at their ends, but they are always a little distance therefrom. They are distinguished one from the other by calling one the South and the other the North pole. The poles of a battery, as before stated, are its ends. The terminating plates or electrodes in a battery composed of a number of voltaic cells are distinguished one from the other by calling one the *negative*, the other the *positive* pole.

The negative terminating plate or electrode is the positive pole, while the positive terminating plate or electrode is the negative pole of a battery. The above should be very firmly impressed on the memory, as this apparent contradiction is a common source of trouble.

Speaking generally, we may say that the *volt-meter* and the *ampere-meter* are simply galvanometers which have their coils especially wound and their dial faces carefully graduated and marked, so that the volts or amperes in a circuit of which they are a part, can be read directly as the weight on a pair of scales or as the pressure on a steam gauge.

A *volt* is the *unit of electro-motive force*, and it is symbolized by E. It is equivalent to the difference of potential between two points, or it is that force which will maintain a circuit of one ampere in a wire having a resistance of one ohm.

The volt-meter is, then, an instrument for measuring the electro-motive force or the E M F as usually written, which is expressed in *volts*.

The E M F is the force which moves electricity. It is sometimes called electric pressure, difference of potential, electric force and potential. The only difference between electromotive force and potential is that the former relates to the *conductive* while the latter relates to the *inductive* circuits. The electro-motive force expresses to the electrician what steam in a boiler does to the engineer.

The *ohm* is the *unit of resistance* and is symbolized by R. One ohm is the resistance through which one ampere of current will flow when driven by a pressure of one volt of E M F.

Electrical resistance is the opposing force to electro-motive force : Resistance to electricity exists more or less in every electrical circuit, just as resistance exists in water pipes to the flow of water through them. The metals are the best conductors of electricity because they offer, compared with other metals, less resistance to the passage of the current. A good conductor renders the same sort of service to the electrician as the large water pipes do to the engineer.

The greater the E M F in proportion to the resistance of a circuit the greater will be the strength of the current, and vice versa. The greater the resistance of a circuit the less will be the current strength. Thus by doubling a given conductor, the strength of the current will be doubled.

The *ampere* is the *unit of current* per second. It is symbolized in formula by C and is that quantity of electricity which flows per second through a resistance of one ohm, at a pressure of one volt of electro-motive force. The ampere-meter is, then, an instrument employed for measuring this current strength, or the intensity of the current in amperes.

The current strength is always directly proportional to the electro-motive force. It becomes proportionately less as the resistance of the circuit becomes greater. When an electro-motive force of one volt drives a current through a resistance of one ohm, that current is said to have an intensity of one ampere.

The fact that electro-motive force and resistance bear a relation one to the other was discovered by "Ohm" who propounded the law of electricity in motion, which now guides the electrician in his calculation. Knowing the current strength and the rate at which the E M F puts it in action, we can readily find the work done, as by multiplying the volts and the amperes we obtain the energy in watts.

The *watt* is the unit of energy or power and is equal to about 1-746 of a mechanical horse-power. With a constant resistance the current is proportional to the electro-motive force with the same difference of potential and it is halved by doubling the resistance. In other words, if we, with a given potential, get an unit of current over a wire one mile long, we get but half this unit of current over the same conductor when it is increased in length to two miles.

Ohm's law expresses the above thus : "C," current strength, "E," electro-motive force ; "R," resistance.

$$C = \frac{E}{R} \text{ or } E = C \times R$$

The current in amperes may be found by dividing the E M F in volts by the resistance in ohms.

To find the electro-motive force in volts of a circuit, it is simply necessary to multiply the current in amperes by the resistance in ohms. The resistance of a circuit may be found by dividing the electro-motive force in volts by the current in amperes.

The *colombe* is the *unit of quantity* and it is symbolized by Q. It is that quantity of electricity which is given by one ampere in one second.

The next most important effect for us to study is the action of the electric current on a bar of soft iron enclosed within a coil of insulated wire in place of the permanently magnetized steel needle we have been dealing with.

Such an arrangement is called an *electro magnet.* The soft iron is called the *core* and the coil of insulated wire surrounding it the *helix*.

A current of electricity passed through the helix will act upon the soft iron core within as it did upon the permanently magnetized needle of the galvanometer. In this instance, however, the iron cores are converted into a powerful electro magnet, one free end of which is said to have North and the other free end South polarity.

The nearer the coils of wire forming the helix are to the soft iron core the greater will be the magnetic effect in the iron when the circuit is completed. A piece of Norway or Swedish iron placed with a coil of wire will, when a current is passed through the coil, become magnetized in proportion to the number of turns of wire around the iron, in proportion to the strength of the current passing through the coils, and in proportion to the distance between the coils of wire forming the helix and the core.

If we place a bar of soft iron in a helix of insulated wire, the ends of which are connected in circuit with a voltaic battery and a key for opening and closing the circuit, we may energize this core at will by simply depressing the key so as to close the circuit. This is the principle of the electric bell and the Morse and other telegraphic instruments. It will readily be understood that the closing of the circuit by depressing the key will act upon the iron core so as to make it a magnet, but only for the time during which the circuit remains closed. On arresting the flow of the current by releasing the key, the magnetic effect in the iron core is also arrested.

The softest iron and the best should alone be selected for the cores of electro magnets, for the reason that good, soft iron immediately parts with its magnetism when the influence of the current is removed by opening the circuit. Whereas hard iron or steel will retain magnetism in proportion to their hardness and consequently will respond to the action of the current proportionately slower.

The quality of the iron for the cores, armatures or field magnets of electrical machines is one of the most important points to be considered in their construction.

Of course work is done in energizing this piece of iron so as to make it an electro-magnet capable of sustaining a considerable weight.

It may be a question with some as to what the source of this energy is. When the current from a battery is emyloyed the energy to do the work is so far primarily due to the chemical energy in the cells which on being converted ints electric energy, act upon the iron so as to cause it to develop energy in the form of magnetism.

When a steam engine is used to drive a dynamo machine to generate electricity the coal burned is so far the source of energy.

It should be remembered that in every transportation of one form of energy into another there is a very considerable loss, therefore the more direct the means of producing and utilizing the current the less will be the loss. A great part of the energy expended in producing the electric-magnetic energy in the soft iron, will, if the core be removed, be expended in heating the wire. The chemical energy of the battery will likewise be expended in producing heat energy in the wire of an helix.

This heating effect will be dealt with presently as fully as space will permit. The heating effect is proportionately less as other work done by the current is proportionately greater.

We have stated that the effect of temporarily closing the electric circuit through the helix is to temporarily magnetize the soft iron core. We may say that the effect of closing a voltaic battery circuit through an electro-magnet is to convert the chemical action developed in the battery into magnetic energy developed in the soft iron core of the electro-magnet. If the core is removed from the helix the same amount of work is still done, but it shows itself in a different way. In this instance the chemical energy developed in the battery would appear in the helix and connecting wire as heat energy.

Iron is the only metal which can be practically employed for electro-magnets, although nickel is acted on in like manner by the current, but in a much slighter degree and at much greater cost. The object of insulating the wire of the helix is to compel the current to travel from one end of the wire to the other.

If the wire actually touched, *i.e.*, made metallic contact at any two points between the ends, the greater part of the current would pass at the point of contact, instead of passing around the convolution of the loop, which would be intermediate in the wire and between the points of contact.

Thus you will understand the necessity for perfect insulation in electric wires.

The current will at all times take the path of least resistance, and rather than go round the coils it will jump across if the insulation is not sufficiently good.

Fig. 1 represents a straight electro-magnet. This, if bent at its centre so that its poles approached each other, would then be called a horse-shoe. The horse-shoe form of electro magnet is considered the best, and in this form it is used in the principal electrical devices.

Iron, then, is employed because in a remarkable degree it has the property of acquiring and losing magnetism very rapidly.

We have learned that an electro-magnet immediately acquires magnetism when a current of electricity is passed through the

wire encircling the core, and that immediately on the cessation of the flow of electricity it almost as readily loses its magnetism. It will readily be understood from Fig. 1 that the closing of the circuit by depressing the Key K will allow the current to flow through the wire around the core and make it a magnet, but only for the time during which the key is depressed and the circuit remains closed. On arresting the flow of the current by releasing the key, the magnetic effect in the iron core is at the same instant also arrested. The softest and the best iron only should be used for the purpose for the reason that cores of electro-magnets composed of good, soft iron retain but little magnetism when the influence of the current is removed by opening the circuit, whereas, if made of cast or an inferior quality of iron the magnetism is retained and the action is sluggish.

Fig. 2 diagrammatically represents an electro-magnet of a form very generally employed for telegraph instruments, electric bells, etc. N and S are simply pieces of round Norway iron screwed by means of an iron screw, or riveted with an iron rivet in the plate B.

It is of the utmost importance that the cores of iron make surface and solid contact with the iron yoke piece B.

C is a simple spring contact key for temporarily closing the electrical circuit when depressed, normally it leaves the circuit open. By depressing the key until it comes in contact with the anvil O, the current will flow from the battery through the key,

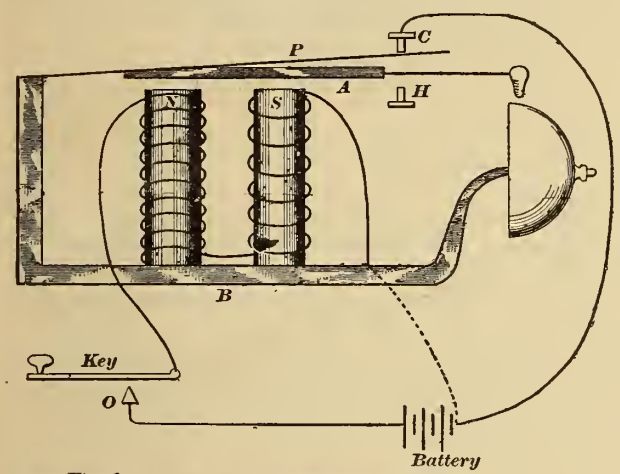
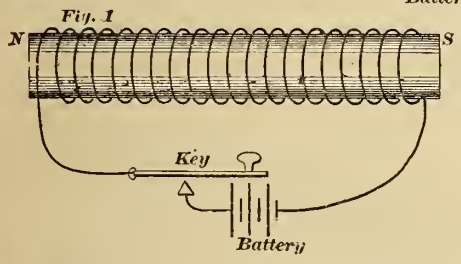


Fig. 1



out by the anvil O, through the helix surrounding N S, to the metal frame along which it travels to the armature A, out by the spring to S and back to the battery at the opposite pole to that from which it entered. The effect of the depression of the key is then to magnetize N S, which attracts the soft iron armature A until the ball at its free end strikes the gong. The instant the hammer strikes the gong the spring will be drawn out of contact with the screw C, and the circuit will be again open for an instant and until the spring and screw C come again in contact. N S will lose their magnetism on the opening of the circuit, and the armature will instantly be carried back by the tension of the spring, and the current will again be established and so on, causing the armature to vibrate and the hammer to strike the gong at each vibration. This is the principle upon which all vibrating bells are constructed.

There is very little difference between the action, etc., of an electric bell and the *Morse* telegraph instruments. If, for instance, we remove the long spring P from the bell armature A, so that the armature plays between the studs C and H, and if we also remove the wire from C and connect it with the end of the helix on S, we then have a simple Morse telegraph instrument, which may be read by the sound of the armature beating against the studs.

If we substitute a stylus for the hammer at the end of armature and cause a ribbon of paper to travel above, but within striking distance thereof, we then have a Morse recording telegraph instrument.

We have already stated that dynamo machines are divided into two classes, viz.: *alternating* current machines which, as their name implies, supply only alternating currents, and *direct* current machines, which generate a current always flowing in one direction. Each machine can use either permanent or electro-magnetic fields.

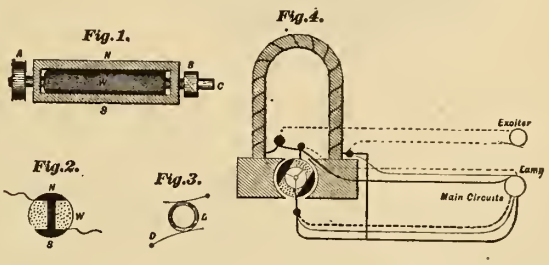
By the difference of the winding and arrangement of the wires, these two classes, *i.e.*, alternating and direct current machines, are again, to meet special arrangements, divided into what are termed *series* and *shunt* wound machines and different combinations thereof.

The series machines give a constant current with a varying electro-motive force, while the shunt wound machines give a varying current and a constant electro-motive force, one being the opposite to the other.

Then, again, there are self-exciting and separately-exciting machines, which may be either shunt or series wound, sufficient magnetism is always retained in the field magnets to feebly act from the start on the armature, which, as its speed of rotation is increased, cuts more *lines of force*, and in proportion thereto, generates a stronger current, which, passing through the field magnet coils in the proper direction, increases the strength of the field magnets, which again in turn so influences or acts upon the armature that it gives out a proportionately increased amount of electric energy. The self-exciting machine would appear to be an electric accummulator. A separately-excited machine is used with alternating current machines unless the latter have a permanently magnetized field.

The exciter is generally a small dynamo, or it may be a voltaic battery, placed in circuit with the field magnet only; its office being to magnetize the field to *saturation*. The commutator on an alternating generator, or machine, is required to convert the alternating impulses into a direct flowing current. Such convertion is sometimes necessary, but whenever resorted to it is attended at all times with a considerable loss of energy.

The alternating machines are more simple in construction and have the advantage of furnishing a higher E.M.F. at less cost than a direct current dynamo machine. They can also be advantageously employed for supplying incandescent lamps, especially on long circuits. For supplying arc electric lights, the direct current machines are best, as they are made simple to



manipulate. They can be used for both arc and incandescent lamps, driving motors or electro-plating, etc., whereas, to do more than to light incandescent lamps the alternating machines have to be furnished with special appliances which increase the cost and the complications.

We would recommend our readers, whose intention it is to build a dynamo machine for their own use, to build it on the Siemens pattern, as this is a simple machine to construct and will, to the amateur, give greater satisfaction than any other.

We may have something more to say regarding the converters and the special apparatus above alluded to. Although the forms of field magnets may differ so much in outward form, the same principles underlie all, as the object of the manufacturer is to construct a machine which will concentrate the greatest number of lines of force on each successive coil of the armature.

The different designs of armatures, although not so numereus as the different designs of field magnets, are far too numerous for us to attempt to describe here. We will, therefore, confine ourselves to two or three of the most simple and generally approved types, commencing with the Siemens and Gramme, which are among the oldest. It would be safe to say that nine-tenths of all the dynamos on the market are simply modifications of one or the other of these.

Fig. 1 shows a longitudinal view of the Siemens armature, N S representing the poles, W the wire, A the driving wheel, B the commutator, and C the shaft.

Fig. 2 represents a cross section of the armature, and Fig. 3 a cross section of the commutator, with the brushes D D resting thereon.

Fig. 4 shows a Siemens armature revolving between the poles of the field magnets. The thin lines represent the circuit or path the current traverses to make it a series-shunt or separately-excited machine. The heavy lines show the complete circuit and winding of the shunt system, and the dotted lines show the circuit of separately-excited field magnets, with winding and circuit complete.—*Scientific Machinist.*

LEGAL DECISIONS.

TELEGRAPHIC CORRESPONDENCE, AGENCY.—According to the decision of the Supreme Court of Minnesota, in the case of Magie *v.* Herman et al., where one commences a correspondence with another by telegraph he makes the telegraph company his agent for the transmission and delivery of his communication, and the transcribed message actually delivered is primary evidence, and if lost or destroyed its contents my be proved by parol.

FLUES IN BOILERS.

A boiler shell, with the pressure acting on it from within, is in a state of stable equilibrium ; for if any small deformation is produced in it, for any cause, the pressure tends to remove the deformation and restore the boiler to the form of a true cylinder. A flue, however, with the pressure on the outside, is in a state of unstable equilibrium, for the pressure tends to magnify all deformations and to cause the flue to depart more widely from the cylindrical form. In other words, pressure tends to keep the shell of a boiler in its strongest shape, and tends to force a flue into its weakest shape. Flues, therefore, are elements of weakness in a boiler, and it is particularly important that proper attention be paid to them.

The U. S. Treasury rules for finding the strength of lap-welded flues are as follows (see *Amended Steamboat Rules and Regulations* for 1891): If the diameter of the flue is not less than 7 inches, and not more than 16 inches, and the length not ovet 18 feet, multiply the thickness of the flue, in

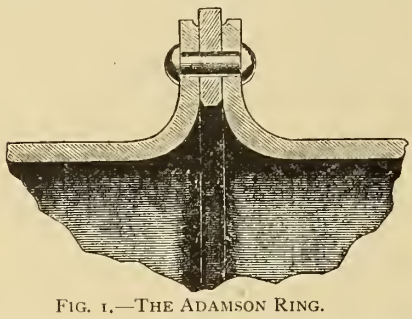


Fig. 1.—The Adamson Ring.

inches, by the constant number 4,400, and divide the product by the radius of the flue in inches. The quotient will be the pressure allowable. "For every foot or fraction thereof over 18 feet, deduct 3 pounds per square inch from the pressure allowable on an 18-foot flue ; or, add .01 of an inch to the thickness of material required for a flue 18 feet in length for every three feet or fraction thereof over 18 feet." The thickness of such a flue as is described above is to be determined by the following rule : Multiply the radius of flue in inches by the pressure per square inch that it is desired to carry, and divide the product by the constant number 4,400. The quotient is the required thickness, in inches. "The thickness of lap-welded flues, however, shall in no case be *less* than the diameter of the flue multiplied by .022."

It is further provided by the Treasury department that "Lap-welded flues 7 inches, and not over 16 inches in diameter, shall be made in lengths of not over three (3) feet and fitted one into the other and substantially riveted ; or in lieu thereof corrugated

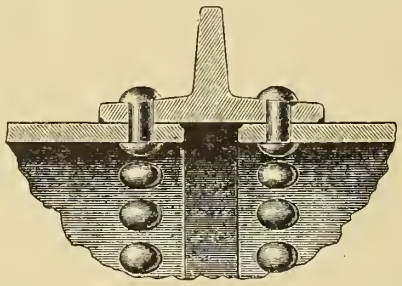


Fig. 2 —T-Iron Ring.

to a depth of not less than three-fourths of an inch outwardly and at a distance of not over three feet between such corrugations : *Provided*, such corrugations are made without in any manner reducing the thickness of the material in the flue at the points of corrugation to less than the least thickness of the material in the body of the flue, or that such flues are made in sections of not over three (3) feet in length, and flanged to a width of not less than two (2) inches, and riveted substantially together with a wrought iron ring (see the cut of the Adamson ring), having a thickness of material of not less than the thickness of material in the flues, and a width of not less than two (2) inches riveted between such flanges."

Flues whose diameter is more than 16 inches and less than 40 inches are separately considered. Of such flues it is required that they "shall be made in lengths of not over three (3) feet, fitted one into the other and substantially riveted ; or flanged to a depth of not less than two (2) inches and riveted together with a good substantial wrought-iron ring between each joint ; and no such ring shall have a thickness of less than half an inch nor a width of less than two (2) inches." The steam pressure allowable on such flues is to be determined by the same rule as that given above for the smaller flues, *except* that in the place of the constant number 4,400 that is given above, we must use the constant number 2,840.

In the *Amended Steamboat Rules and Regulations* for 1892 there appears the following modification for the rule given above as applying to lap riveted flues not over 16 inches in diameter : "But when such flues are used under a pressure of over 60 pounds and less than 120 pounds to the square inch, they may be made in sections of not over 5 feet in length and connected in the manner prescribed for sections 3 feet in length, and all lap-welded flues and tubes using 120 pounds of steam, and under, shall have a thickness of material of not less than the standard thickness. The following shall be the standard thickness of lap-welded flues and tubes from 1 to 16 inches in diameter using steam under 120 pounds to the square inch :

Outside Diameter.	Thickness	Outside Diameter.	Thickness	Outside Diameter.	Thickness	Outside Diameter.	Thickness
1 in.	.072 in.	2¾ in.	.109 in.	5 in.	.148 in.	12 in.	.229 in.
1¼	.072	3	.109	6	.165	13	.238
1½	.083	3¼	.120	7	.165	14	.248
1¾	.095	3½	.120	8	.165	15	.259
2	.095	3¾	.120	9	.180	16	.270
2¼	.095	4	.134	10	.203		
2½	.109	4½	.134	11	.220		

Although the foregoing regulations of the Treasury department relate to lap-welded flues, they would doubtless be also applied to rolled flues when used in the marine service, notwithstanding the fact that the rolled flue is somewhat stronger, on account of its more perfectly cylindrical shape. Rolled flues are used in land boilers to some extent in this country, and very generally in England and other parts of Europe. Until recent years it was not found practicable to roll them in lengths of more than three feet or so, and where they were fitted together at the ends, and riveted, the double thickness of metal at the joint served as a sort of stiffening ring, and unless the pressure to be carried was high, engineers did not consider it necessary to provide additional rings for securing the necessary stiffness and resistance to collapse.

The method of joining the sections of the flues that is referred to in the Treasury rules above given is illustrated in Fig. 1, which shows what is technically known as the "Adamson ring," from its having been first introduced by Mr. Adamson, in 1851. The ends of the section are flanged outward, as shown, and are securely riveted together with a ring of wrought-iron or steel between. This ring, which should be not less than half an inch thick and not less than two inches wide, is caulked on the outer side of the joint, and if the flue is large enough to admit of it, it is also caulked on the inside, as indicated in the cut. One of the important features of this joint is that both the flanges and the rivets are entirely protected by water. There is also no thickening of the flue by overlapping pieces, so that the joint is not likely to burn out. Mr. Adamson has submitted these flanged joints to severe experimental tests, which they withstood remarkably well. The only serious objection that has been urged against them is, that in case one of the segments of the flue should burn out, either on account of scale or for any other reason, it could not be replaced without removing the head of the boiler. This objection does not seem to us to have any great weight, because in many cases the flue comes so close to the shell that it is almost impossible to do a satisfactory job of riveting or any kind of a joint, without removing the flue from the boiler ; and if there are projections of *any* sort upon it, it will be necessary, in removing the flue, to take out one of the heads.

Fig. 2 shows a method of uniting the parts of a built-up flue, which may be used with advantage in some cases, though we should prefer the Adamson joint shown in Fig. 1. Fig. 2 shows a ring of T-shaped wrought-iron which is preferably made in one piece and shrunk on the ends of the segments to be united ; though it may be made in halves, if necessary, the two parts being riveted firmly together when in position, by running straps along the web of the flange on both sides near the joint, and

riveting through both straps and the web. When the flue is large enough to admit of it, the joint should be caulked both inside and out, as indicated in the cut. If the flue is too small for this, there is no necessity of having the abutting ends of the flue as far apart as they are shown in the cut. T-shaped wrought-iron rings, similar to that shown in the figure, and made in halves, are sometimes riveted directly to the flue, midway between the joints, when the flue, either through age, through increase of pressure or through faulty design, requires more stiffening than the builder has given it. Rings of angle-iron are also used for this purpose.

Fig. 3 shows a ring of steel, hoop-shaped in section, which is sometimes used in building up flues in the place of the T-iron

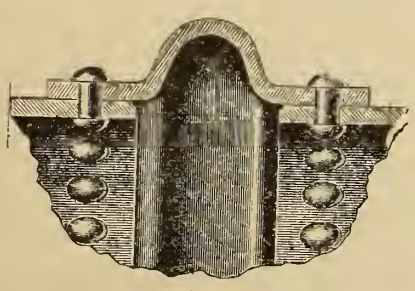
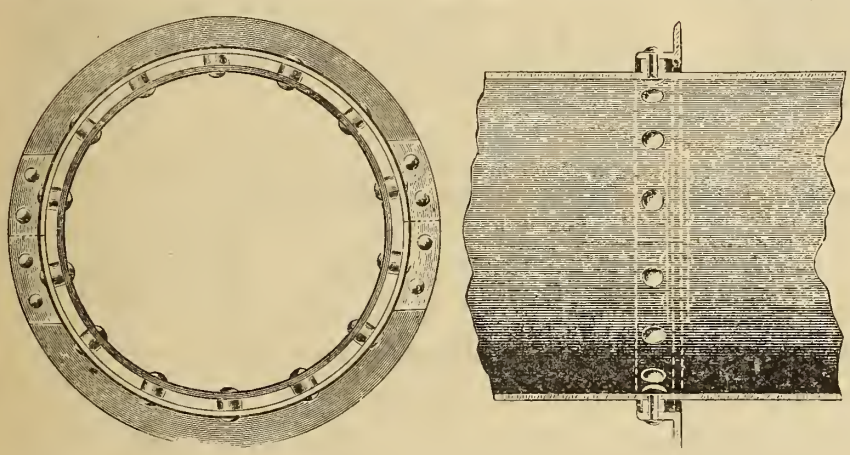


FIG. 3.—STEEL HOOP.

ring illustrated in Fig. 2. The advantage claimed for this form of joint is that it has a certain amount of elasticity, and that it yields sufficiently to prevent any very severe strain from unequal expansion and contraction in the flue and boiler. This form of ring should be made in one piece and be shrunk on, and then riveted. It should be caulked on the outside, and on the inside also, if the flue is large enough to admit of it.

At the present time, flues are rolled of all lengths up to 18 feet. If a longer boiler is required 21 feet long for example, it is customary to use a rolled flue 18 feet long, pieced out with an additional section three feet in length. The joint where the flue sections come together gives stiffness enough, ordinarily, to prevent the collapse of the shorter segment; but the long section should be supported by some additional means. Rings of angle-iron, or T-iron, like that shown in Fig. 2 may be riveted around the flue at intervals of from 3 to 5 feet, to give the necessary stiffness, or the device shown in figures 4 and 5 may be



FIGS. 4 AND 5.—RING OF ANGLE-IRON, WITH THIMBLES.

adopted. There is some liability to overheating when the angle-iron is riveted directly to the flue, yet this is often done without giving rise to any such trouble. The ring shown in Figs. 4 and 5 seems superior to the plain ring, however, because water can circulate freely between the rivets, cooling both the rivets and the flue, and greatly lessening the likelihood of overheating. It consists of a ring of angle-iron or U-iron made in halves, with the ends riveted together in a double-strap, as indicated in the cuts. There is a free space of about one inch between the ring and the flue, all around, and the two are kept apart by thimbles that are spaced 5 or 6 inches apart. The ring and the flue are secured to one another by rivets which pass through the thimbles, as shown, and are headed over inside of the flue and outside of the angle-iron or U-iron. These rings are used in England much more than in this country, because flue boilers are much more common there than here. It will be interesting, therefore, to quote the opinion of Mr. Henry Miller, Chief Engineer of the National Boiler Insurance Company, with regard to them, as he is thoroughly familiar with the best English practice. "The angle-iron," he says, "should not be less than 3 in. x 3 in. x 9-16 in. The ferrules between the hoop and the plate should be about one inch thick, [*i. e.*, one inch long], and the rivets should be spaced about six inches apart. With the exception of the part that requires riveting over, the rivet should be as cool as possible when it is inserted, as otherwise the excessive contraction in so long a rivet will be likely to induce such a strain as to fracture the head. The ferrules should fit tightly between the hoop and the flue, and the rivets should fill the ferrules." These rings are made in halves, as explained above, and the ends of the halves are made to butt together and are secured by securely riveting a double strap to the web of the ring where the joint comes, in the manner indicated in the cuts.

Mr. Miller does not recommend this form of ring for new boilers, nor do we, unless there is some special reason for it. It is often serviceable, however, when the flues of a boiler were originally made too weak for the pressure it is desired to carry. For new work we strongly recommend Mr. Adamson's joint, shown in Fig. 1, or the steel hoop shown in Fig. 3. A few years ago a ferry boat plying about New York City was built with rings of this sort around her flues, except that in place of the angle-iron shown in Figs. 4 and 5, half round iron 2½ inches wide and 1½ inches high was used. The rings were placed along the flues at intervals of about twenty inches, and the rivets were spaced 8 inches apart. This stiffening proved insufficient, and a vast amount of trouble resulted. In our opinion the rings used in this case were much too small, and were weak in shape. The flue was 36 inches in diameter, and in this form no strengthening ring was to be used at all, a heavy ring of angle-iron should have been employed in the place of the weak, half-round strips. If we remember rightly, the trouble was removed by the substitution of corrugated flues for the plain ones.

It may be well to say in this place that we do not approve of flue boilers as a general rule. There seems to be no especial advantage in them and they are inherently weaker than the tubular form. We believe that greater safety and economy, and more general satisfaction, can be had from tubular boilers than from any other form. Flue boilers are used in some parts of the country in sawmills, where refuse is burned for fuel; and we have known the owners of these mills to object to tubular boilers because they *were* economical. It was necessary, they said, to burn all their refuse, and if the boiler wouldn't do it, it was necessary to have separate furnaces constructed for the purpose. Nowadays, when all things are put to use and the word "waste" is nearly obsolete, we seldom hear this objection urged.

There are other points that should be mentioned in connection with flues, and we shall return to the subject in a later issue.—*The Locomotive.*

EXTENSION OF THE BELL TELEPHONE SYSTEM.

THE trunk lines of the Bell Telephone system were largely extended in Ontario during the last year, and greater extensions and improvements are projected for the coming year. New metallic through wires and wires for way stations are to be erected from Toronto to Barrie, Orangeville, London via Guelph and Stratford; from Chatham to Windsor, and from Hamilton to Niagara Falls, to complete the line from Detroit and Windsor through London and Hamilton to Niagara Falls and Buffalo, and thence to all points in New York and the adjacent States; also from Port Hope to Kingston, to put that city, with Belleville and the neighboring towns, in communication with subscribers in Toronto and points farther west.

The new pole routes will all be of the most substantial construction, and the wires of copper and doubled in all cases, so that the annoying effects of induction from electric railway and electric light currents will be done away with and the company able to offer to its subscribers who have metallic circuits to their exchanges perfectly silent lines.

The Bell Telephone Company at Buffalo, with its numerous connecting lines, will meet the Canadian company at the Falls, thus preparing the means for conversation between Toronto and New York and other American cities.

TRADE NOTES.

Messrs. Barber & Bates, of Meaford, are supplying a 24 inch Turbine water wheel to the Preston Electric Light Co,

The Reliance Electric Mfg. Co., of Waterford, Ont., report having sold a 150 h. p, generator for power plant at St. Catharines ; also to Cook & Son, of the same city, two 25 h. p. and one 10 h. p. motor.

Messrs. F. E. Dixon & Co., Toronto, have just finished the manufacture of two belts for the Toronto Electric Light Co., the combined length of which is about 260 feet. The width of each belt is 33 inches.

The Royal Electric Co. report the following sales for November :—Gravenhurst Electric Light Co., Gravenhurst, Ont., 15 light arc dynamo, lamps and wire : Victoria Electric Light Co., Lindsay, Ont., 35 light arc dynamo, lamps and wire, 700 light alternator, lamps and wire ; Standard Electric Co., Ottawa, Ont., 5,000 light alternator and transformers ; Sherbrooke Gas Co., Sherbrooke, Que., 650 light alternator and transformers ; Quebec and Levis Electric Light Co., Quebec, Que., 2,000 light alternator and transformers ; Tooke Bros., Montreal, Que., 350 light incandescent, dynamo and lamps ; E. Ives & Co., Coaticooke, Que., 650 light alternator and transformers ; St. Johns Electric Co., St. Johns, Nfld., 50 light arc dynamo and lamps ; Consolidated Electric Company, St. John, N. B., 125 h. p. generator for street railway ; Hamilton Electric Light and Power Co., Hamilton, Ont., 1,500 light alternator, 125 h. p. generator for power purposes, 50 light arc dynamos ; Toronto Railway Co., Toronto, Ont., 6 h. p., 500 volt motor ; also a number of small motors and isolated incandescent plants. Up to date the company have equipped 15 cars for the Montreal Street Railway, with two 25 h.p. motors each, and have 14 more equipments ready to mount, a portion of which go to Winnipeg and Toronto.

For about two years past the Toronto and Richmond Hill Street Railway Co. have been making preparations to construct an electric railway to Richmond Hill. The County Council, at its session a few days ago, granted a franchise to the Metropolitan Electric Railway Co. to extend their lines over the same route, but were restrained by an injunction.

THE TELEGRAPH WIRE.

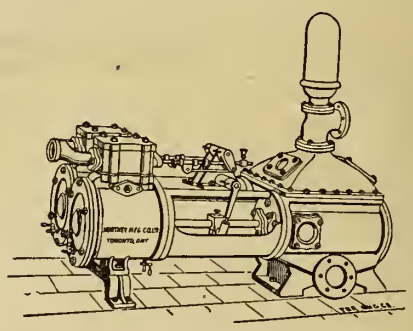
Thar's many a little tragic tale
Is spun un th' thrummin' wire ;
Thar's many a sob, an' thar's many a song
Is sung to the hum o' th' wire,
We know by th' hum and th' thrum overhead
Thar's some un is born er thar's some un is dead,
As the news like th' lightnin', click ! is sped
On th' telegraphic wire.

Thar's somethin' about th' yaller note
Thet th' sighin' wires send,
Thet makes a man's heart sneak up in's throat
Till he's torn the mucilaged end.
Fer meybe it tells ye ye're rich fer life ;
An' meybe it tells ye ye've lost a wife.
Thar's the hummin' o' peace an' th' thrummin' o' strife
On th' telegraphic wire,

Each click ! click ! click ! strikes a note in the heart
That either'll cord er jar ;
It is either a salve to soothe a smart
Er a probe to scratch a scar.
It mey be th' honey th' busy bee sips,
It mey be th' poison from waspish lips,
Thet is dropped from th' agent's finger tips
On th' telegraphic wire.

—"J. KOBR" in Wiunipeg *Free Press.*

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ALL SIZES AVAILABLE, and we will either cut to size or in rough split sheets, with edges trimmed or untrimmed, as may be desired. We will cut discs or segments of circles when required.

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A SIMPLE MAGNETIC INDICATOR.

PROF. W. M. Stine, Physical and Electrical Department of Ohio University, writes as follows: Those having charge of dynamos would often like to know the distribution of the external lines of force in their machines, and much useful knowledge could be obtained in this way. If a magnetic needle is used, it is very apt to change its polarity; it can only indicate in one plane; and in no case can it present a complete picture to the eye. Iron filings, when sprinkled on glass or paper, give a more complete and satisfactory picture, but the use of filings is not only limited to horizontal positions, but they may be drawn into the dynamo and make serious trouble.

It occurred to the writer, while looking at the excellent maps in Carl Hering's "Dynamo Electric Machinery," that they could have been more accurately drawn had iron filings, at least, supplemented the magnetic needle. With this in mind, an indicator was prepared by placing about half an ounce of filings in a mortar and grinding them as fine as possible, and then placing them in a four-ounce flat bottle filled with concentrated glycerine. The high viscosity and specific gravity of the glycerine hold the filings in suspension and when the bottle is brought near the dynamo the lines of force appear very clearly. Since they are shown in three-dimensional space, they appear as they really are in space. When the bottle is held near the head of a bolt or sharp projection on the frame the magnetic discharging power of a point or edge becomes quite apparent. These projections are defects which still exist in many dynamos.

If the bottle is passed along a field coil, in many cases it will show that lines of force pass out thickly from a section of the winding and return a few inches farther along the coil. The relative intensity of the leakage can, at the same time, be seen. These are only a few of the many interesting facts which this simple indicator reveals, and other applications can be readily suggested. It is advisable to use a large flat bottle of clear glass in order to obtain the best results.

THE "CLARK" WIRE.



Insulation Guaranteed wherever used, Aerial, Underground or Submarine.

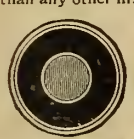


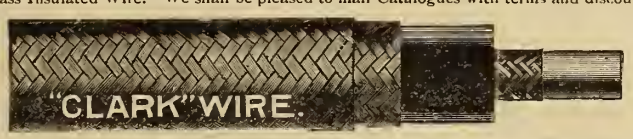
In a letter from the Inspector of the Boston Fire Underwriters' Union, he states: "A thoroughly reliable and desirable Wire in every respect."

The rubber used in insulating our wires and cables is especially chemically prepared, and is guaranteed to be water-proof, and will not deteriorate, oxidize or crack, and will remain flexible in extreme cold weather and is not affected by heat. The insulation is protected from mechanical injury by one or more braids, and the whole slicked with Clark's Patent Compound, and special extra finish, which we have now adopted for all our solid wires as an extra weatherproof protection, and also preventing chafing and abrasion, which is water, acid, and to a very great extent fireproof. Our insulation will prove durable when all others fail. We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph and Electric Lights from stock. Cables made to order. We are now prepared to furnish our Clark Wire with a white finish for ceiling cleat work as well as our standard color.

Clark Joint Gum should be used for making waterproof joints. This is put up in half-pound boxes, in strips about one foot long and five-eighths inch wide, and when wrapped about a joint and pressed firmly it makes a solid mass. **For railway** and **Motor** use, we make all sizes of stranded and flexible with Clark insulation.

We guarantee our Insulation wherever used, Aerial, Underground, or Submarine, and our net prices are as low, if not lower, than any other first-class Insulated Wire. We shall be pleased to mail Catalogues with terms and discounts for quantities.





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BOSTON, - MASS.
HENRY A. CLARK, Treasurer and Gen'l Manager.
HERBERT H. EUSTIS, President and Electrician.

SPARKS.

The Western Union Telegraph company have decided to increase their capital stock from $13,000,000 to $100,000,000.

To prevent rubber gaskets from sticking to hand-hole plates, give them a coat of common whitewash or plumbago.

The Peoples' Electric Light Co. has been organized at Windsor, Ont., with a capital stock of $50,000, to operate the Edison plant.

A movement is on foot in Montreal to form a local association of the workmen in the employ of the telegraph, telephone and electric street railway companies.

The Nanaimo Electric Light Works have been sold by auction to Mr. Emerson, of New Westminster. The price paid was $25,040, which is said to be less than one-half the original cost.

The Canadian Whitney-Hoyt Electrical Instrument Co. has taken a five years' lease of part of the building formerly occupied by the Edison Co. at Sherbrooke, Que., with the object of manufacturing for the Canadian market.

A man whose wagon was damaged by coming in contact with an electric car in Hamilton, last July, brought suit against the Street Railway Co., urging that the accident was due to carelessness on the part of the motorman. The judge nonsuited the plaintiff.

What is said to be the largest generator ever installed in Canada, will be placed in the power station of the Ottawa Street Railway Co. The weight of the machine is 33,000 pounds, and it will furnish current for the operation of the road and for heating purposes.

The St. Henri Light and Power Co., which was recently granted a charter by the Quebec Legislature, empowering it to deal in electricity, gas and other illuminants, and to lay pipes or erect poles in any city, town or municipality in the Province of Quebec, including the city of of Montreal, will endeavor to secure the Montreal lighting franchise, both for gas and electricity on the expiration of the present contract. It is said that English capitalists have offered to take up all the available stock of the Company, the capital of which is placed at $1,000,000. A drop in the stock of the Montreal Gas Co. has followed the announcement of the above facts.

Packard High Grade Incandescent Lamps

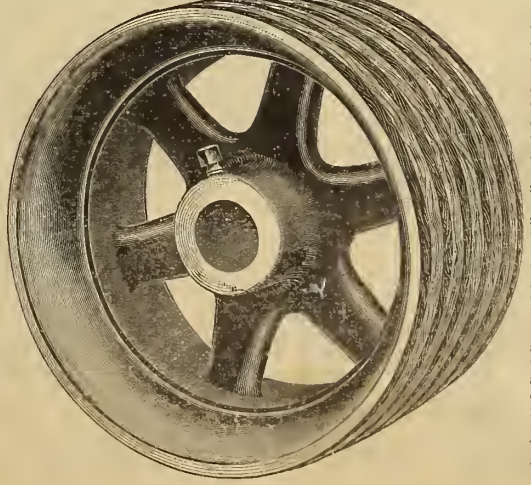
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DODGE WOOD SPLIT PULLEY CO.
83 King Street West, Toronto.

SPARKS.

Owing to the discomfort caused by smoke and gas in the St. Clair tunnel, the G. T. R. Co. are considering the question of operating the cars through the tunnel by means of electricity.

The Brantford Electric Light Co. has been incorporated with a capital of $150,000. Messrs. Wm. Buck, Geo. C. Schultz. H. B. Leaming, A. Watts, G. H. Wilkes and J. W. Digby are the promoters of the Company.

The London City Council propose to substitute for the taxes imposed on the Street Railway Co.'s property, amounting to about $600 a year, a mileage rate of $200 a mile. The company operate about 11 miles of track, which under the proposed arrangement would compel them to pay a yearly tax of $2,200.

Opposition to the construction of the proposed electric railway between Hamilton and Guelph, is said to have arisen in the latter city, on the ground that the new road would be likely to divert trade from Guelph to Hamilton, unless it were extended further north. The consent of all the municipalities through which the road is to run has been obtained.

New Facts about the Dakotas

is the title of the latest illustrated pamphlet issued by the Chicago, Milwaukee & St. Paul R'y regarding those growing states, whose wonderful crops the past season have attracted the attention of the whole country. It is full of facts of special interest for all not satisfied with their present location. Send to A. J. Taylor, Canadian Passenger Agent, No. 4 Palmer House Block, Toronto, Ont., for a copy free of expense.

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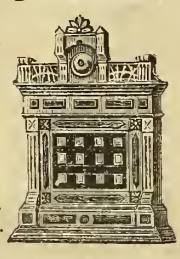
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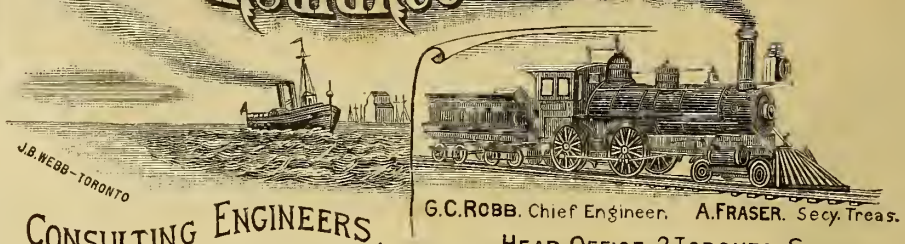
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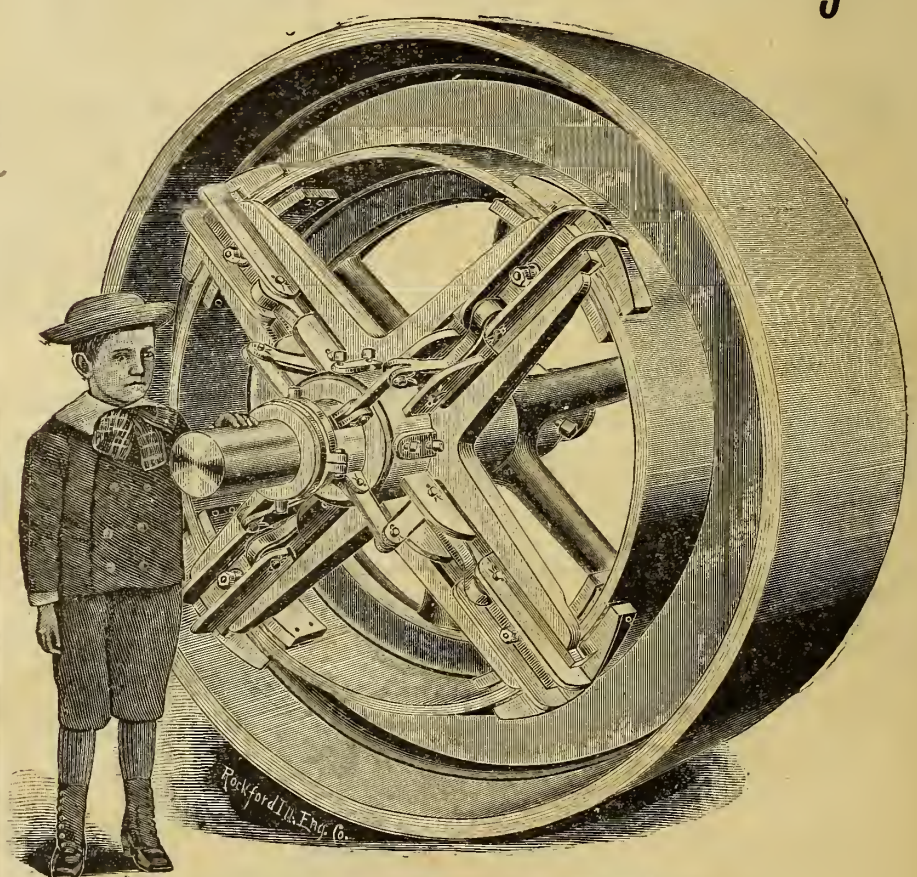
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